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Cast Iron Pipe Centrifugally

Rotating Chill Molds Used to Form Bell and Spigot Type Cast Iron Pipe—Core Required Only for Bell End—Use High Silicon Mixture and Anneal Product

BY E. C. KREUTZBERG

CASTING iron pipe by the new deLavaud centrifugal process now is a standard production method used by the United States Cast Iron Pipe & Foundry Co. A year ago, after conducting extensive experimental work at its Burlington, N. J., plant, which put the new process on a commercial production basis, the company installed four centrifugal machines at Birmingham, Ala. Their performance has fulfilled all expectations as to the efficiency, practicability and economy of the new process. Production of pipe per man by the deLavaud process is said to be 100 to 150 per cent greater than by the sand-cast method formerly used. The United States company now is making arrangements to expand the present battery to include a fifth machine and to install a second battery of five machines at Birmingham, as well as install a 10-machine plant at Burlington. This will make a total of 20 machines in service in the shops of this company. Further, the National Cast Iron Pipe Co., Birmingham, also is about to install five centrifugal machines.

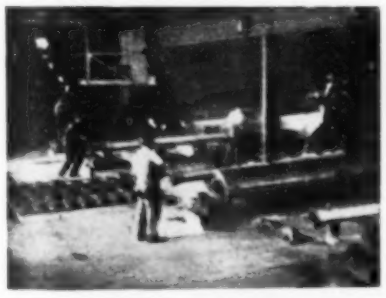


FIG. 1—BEFORE STARTING A SUPPLY OF CORES FOR THE BELL ENDS ARE SUPPLIED NEAR THE MACHINE

By the new process, the iron flasks and core bars, the sand and clay, and the hay, straw or shredded wood rope used in making cast iron pipe are eliminated. In the deLavaud process the pipe is cast in a revolving steel cylindrical mold, the interior surface of which corresponds in every detail with the exterior of the pipe to be cast. Molten iron is poured through a spout extending through to the end of the mold, and as the iron begins to flow the cylinder develops two motions. One is a revolving motion, by which the iron is distributed centrifugally against the inner circumference. The other is a longitudinal movement by which the mold is drawn back, permitting the end of the spout to deliver molten metal along the inner surface of the revolving mold until the spout emerges from the end at which it entered.

In addition to the great increase in the output per man, a saving in the metal is effected. By the sand-cast method, shifts in the position of the core at times cause one side of the pipe wall to be thinner than intended and the other side correspondingly thicker. For this reason, it has been customary in sand-cast pipe to allow ⅛-inch greater wall thickness than would be required if the section were uniform throughout. No core is used in the deLavaud process and casting pipe centrifugally assures uniform wall thickness. Therefore, it is unnecessary to allow excess metal to compensate for variation. By the former method, it was customary in a 6-inch pipe for ordinary pressure to allow a wall thickness of 0.48-inch, subject to ⅛-inch variation. In the centrifugally-cast product designed for the same pressure, the metal is 0.35-inch thick for the 6-inch size, and the thickness increases approximately 0.03 to 0.04-inch for each succeeding size. The saving in tonnage as a result of the decreased wall thickness is about 25 per cent. A 6-inch sand-cast pipe, for instance, weighs 400 pounds, whereas a 6-inch pipe made in the permanent mold weighs 300 pounds. While the saving in tonnage is 25 per cent, the saving

FIG 2—EACH CORE IS HELD IN A METAL BLOCK KEYED TO THE MOLD AND ROTATING WITH IT

in the cost of the metal is slightly less, inasmuch as it is at present to cast the deLavaud pipe with pig iron higher in silicon than is used in sand casting.

The average analysis of the iron used in the centrifugal pipe is given as follows:

	Per cent
Silicon	2.50
Sulphur	0.06 to 0.07
Manganese	0.60, approximate
Phosphorus	0.70 to 0.80

The deLavaud centrifugal casting machine comprises parts having three main functions. In addition, to the steel cylinder which constitutes the mold, the driving and cooling system and the pouring mechanism are essential features. The ends of the steel cylinder or mold revolve in bearings supported in the ends of a hollow, cast iron cylindrical jacket, shown at *A*, Fig. 6. This jacket is about 30 inches in outside diameter for the 4, 6 and 8-inch pipe and somewhat larger for the 10 and 12-inch sizes. The space between the outside of the mold and the inside of the jacket is given over to the cooling water and driving unit.

Use Water Power

The latter is a Pelton water wheel, which is attached to the bell end of the mold shown in the foreground. The water which drives the Pelton wheel, thus revolving the mold, also cools this end of the mold. A cast iron partition divides the Pelton wheel space away from the remainder of the jacket. The latter receives its supply of cooling water independently, through a pipe located along the bottom of the main body of the jacket and which is perforated at regular intervals so as to permit uniform distribution of the water. The mold rests upon four roller bearings which are built up on the bottom of the cast iron jacket. By reason of these roller bearings and because the mold virtually floats in the water contained in the jacket, the revolving motion of the mold is smooth and free from vibration.

In addition to the revolving motion of the mold in the water jacket, the entire machine has a longitudinal motion to and from the pouring ladle. The longitudinal motion is accomplished by a hydraulic ram which moves the machine back and forth along its rails. The ram is built in two parts which telescope, so that its length continually adjusts itself to the travel of the machine. The movement of this ram is controlled by valves located near the tilting ladle. Incidentally, the pipe which supplies water for actuating the Pelton wheel is passed through the interior of the ram. This pipe, as well as the external pipe which feeds into the cooling jacket, telescopes in the same manner as the ram. Among the requirements in taking care of these machines, therefore, is the necessity for numerous water-tight packings.

Because the machines are operated

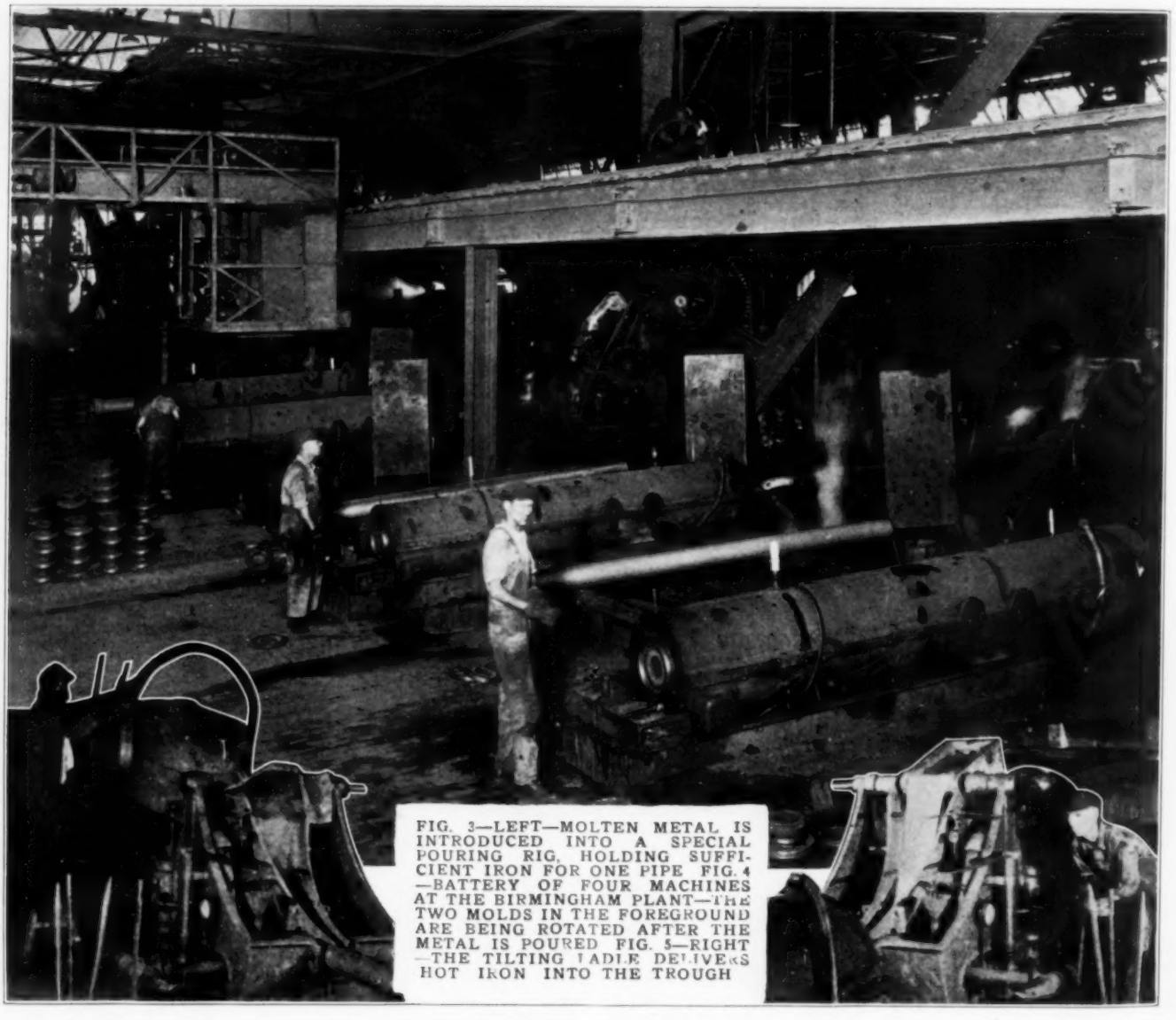


FIG. 3—LEFT—MOLTEN METAL IS INTRODUCED INTO A SPECIAL POURING RIG, HOLDING SUFFICIENT IRON FOR ONE PIPE FIG. 4—BATTERY OF FOUR MACHINES AT THE BIRMINGHAM PLANT—THE TWO MOLDS IN THE FOREGROUND ARE BEING ROTATED AFTER THE METAL IS POURED FIG. 5—RIGHT—THE TILTING LADLE DELIVERS HOT IRON INTO THE TROUGH

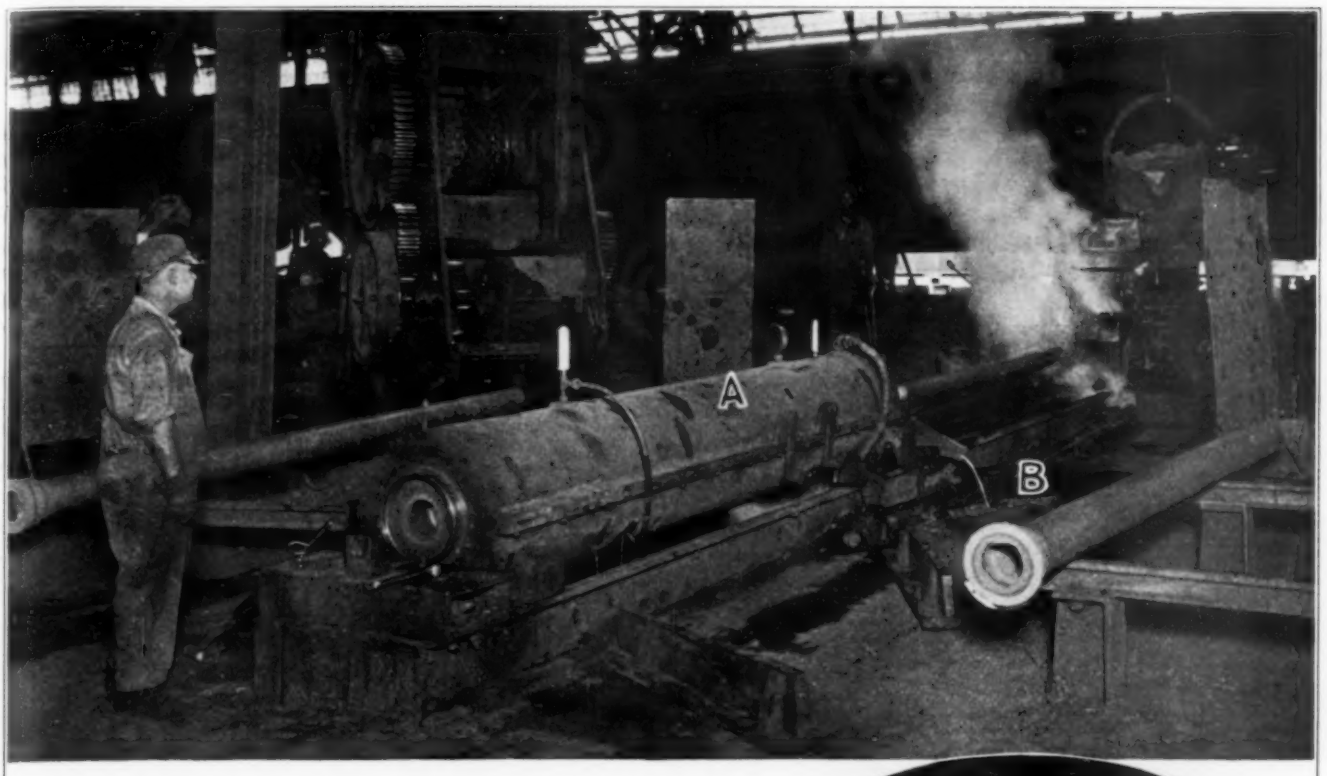
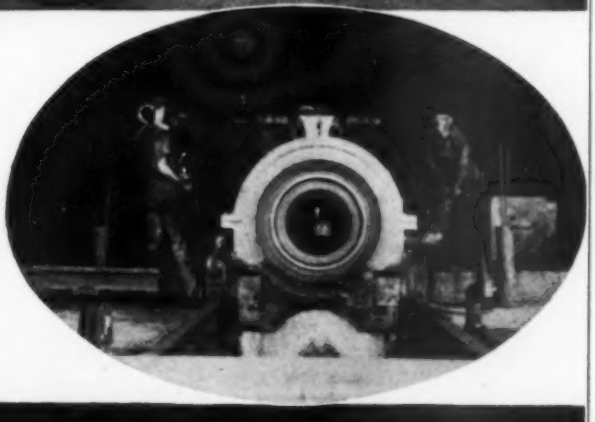
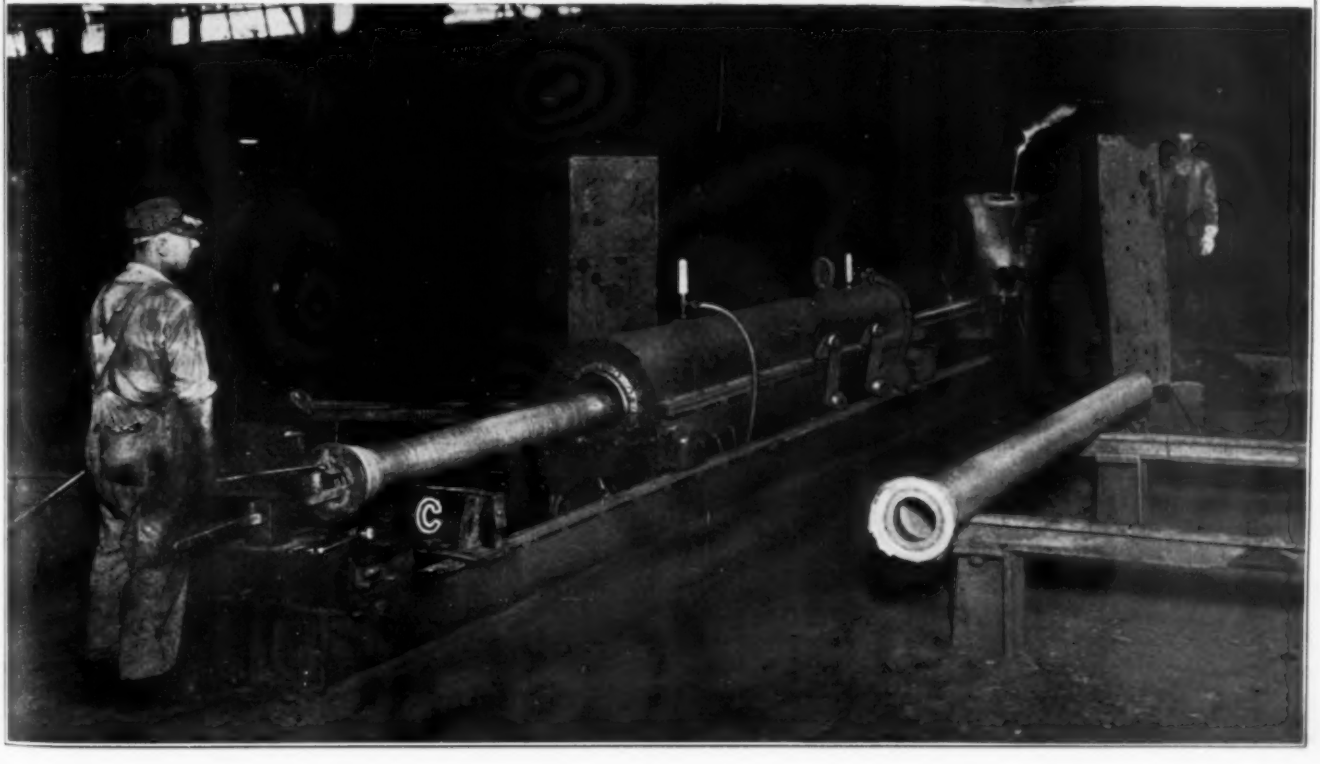


FIG. 6—ABOVE—FINISH OF THE POURING OPERATION ON A 6-INCH MACHINE—THE MOLD IS BEING ROTATED AS THE METAL SOLIDIFIES, WHILE THE EXCESS FROM THE POURING TROUGH IS PIGGED FIG. 7—BELOW—PIPE IS WITHDRAWN BY MOVING THE MOLD TOWARD THE BASIN, THE BELL BEING GRIPPED AND HELD TO A FIRMLY ANCHORED BLOCK FIG. 8—INSET—ROTATION IS STARTED AS THE METAL ENTERS THE POURING TROUGH





hydraulically throughout, considerable attention has been paid to the water supply and pressure. The Pelton wheel and the ram are driven by water under pressure which is supplied through an accumulator designed to give a constant pressure. The cooling water which passes through the main body of the water jacket is maintained at a lower head. Each machine is provided with a thermometer and a vacuum gage. The thermometer shows the temperature and the gage the pressure of the cooling water.

The pouring mechanism for each machine consists of a tilting ladle, a cast iron spillway and a long cantilever trough which terminates in the pouring spout. The tilting ladle is governed by a hydraulic cylinder, with needle valve control which may be adjusted to any required tilting speed. Thus, the flow of iron may be regulated in accordance with the requirements of the pipe being poured. A little more iron than needed is placed in the tilting ladle before each cast. After the pipe has been cast, the surplus iron is poured off into a pig mold as it is too cold to be used in the next cast. This procedure may be noted at *B*, Fig. 6. These pigs are collected each day and remelted in the cupolas. From the tilting ladle, the iron flows down the spillway into the trough. The latter is sufficiently long to extend horizontally through the mold, so that pouring is started at the bell end and as the mold is drawn away, metal is distributed over the entire length.

Each machine is supported on a concrete foundation, and is inclined somewhat from the horizontal, the upper or spigot end of the machine being slightly higher than the lower, or bell end. When the pipe is about to be poured, the machine is advanced the limit of its travel in the direction of the pouring ladle. In this position, the pouring spout is at the bell end of the mold as was noted. Inasmuch as the pipe is cast centrifugally, if some means were not used to hollow out the bell end, a surplus of metal would flow into this end, resulting in a bell of the correct outside contour, but with the inner surface the same diameter as the inside of the pipe. A sand core is inserted in the bell end of the mold, held in place by clamps to form the hollow bell. As the iron enters the mold, the latter is revolved at the proper speed and the mold moved away from the pouring ladle at a uniform speed, until the entire length has been poured. When the machine reaches its limit of travel in this direction, a tackle is thrust into the newly cast pipe. This securely grips the interior of the pipe as shown at *C*, Fig. 7, and when the motion of the machine is reversed, withdraws the pipe from the mold. Steel shod wooden supports are placed beneath the pipe to support it as it is withdrawn from the mold.

As previously stated, three movements must synchronize so that the machine may function properly. These are the tilting speed which regulates the flow of iron from the ladle, the time of travel of the mold away from

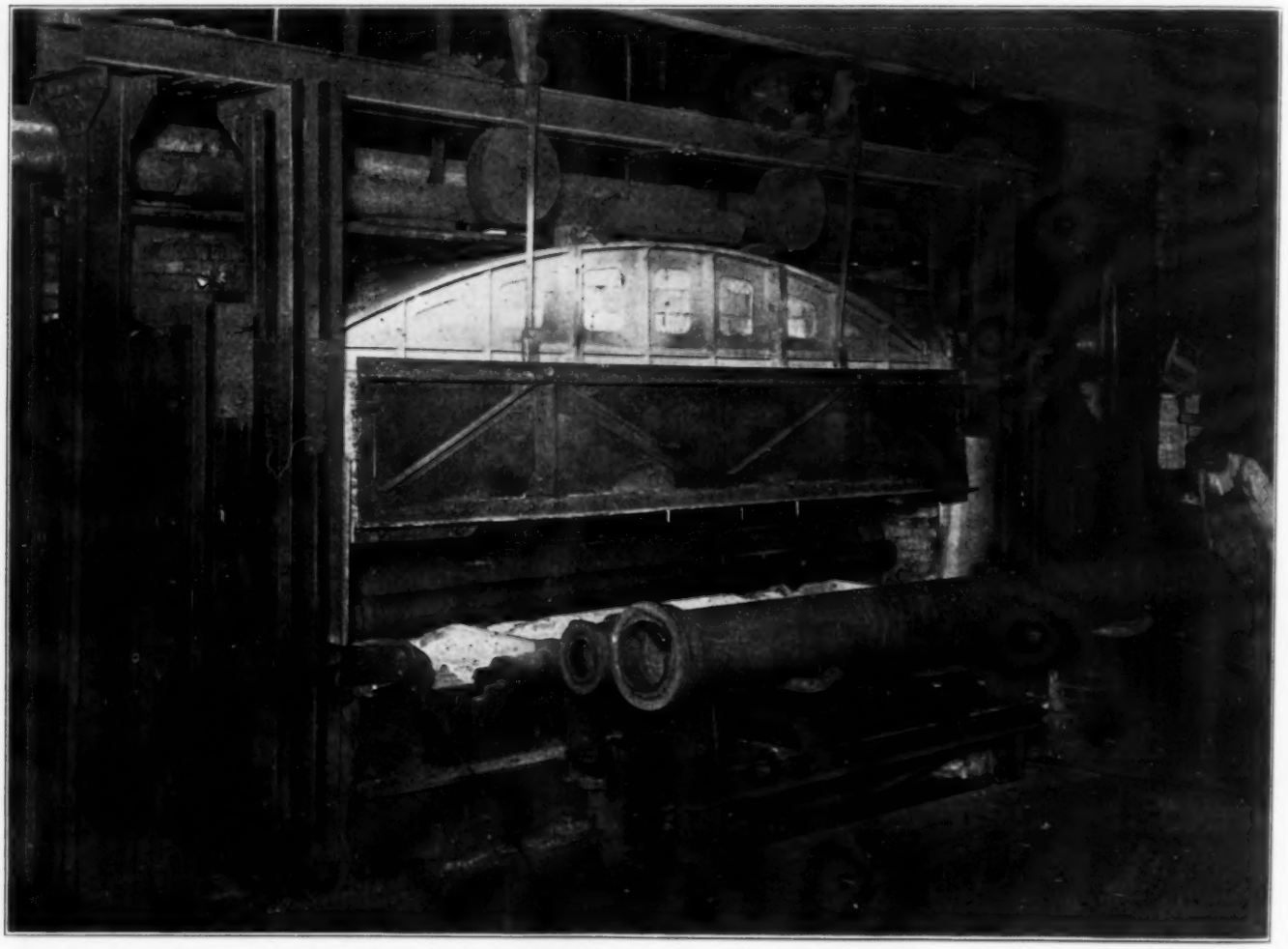


FIG. 9—AFTER REMOVAL FROM THE MACHINE AND BEFORE THEY COOL, THE PIPE ARE ANNEALED—A SCALE AT THE FRONT OF THE ANNEALING FURNACE CHECKS THE WEIGHT AND ASSURES THAT CORRECTIONS CAN BE MADE AT ONCE IN EVENT OF VARIATION FROM THE ESTABLISHED STANDARD

the ladle end of the machine and the number of revolutions per minute of the mold. These various speeds differ for each size of pipe, but the tilting speed and the longitudinal movement of the machine are based upon the number of revolutions of the mold per minute. By changing these speeds, the changes in wall thickness of the pipe are effected.

Four in Service

The present battery of four de Lavaud machines is arranged in a row, the machines being parallel to each other, as shown in Fig. 4. All batteries to be built in the future will be arranged in the same way. Two of the existing machines produce 5 and 6-inch pipe, and the two others, 8, 10 and 12-inch. The fifth machine, which will complete this battery, will produce 6-inch sizes. Later the company will produce larger sizes by this method. The upper end of the deLavaud floor is served by two cranes, one jib and one monorail. The jib crane serves the molten iron from the cupolas in bottom pour ladles. The ladles then are transferred by the monorail crane to the tilting ladle at the head of each machine. One crane serves the lower end of the floor, removing the pipe to the annealing department as rapidly as they are withdrawn from the machines. After the fifth machine has been added to the present battery and a second floor of five machines installed, a total of three cranes will be so located as to serve the lower ends of the two floors.

A crew of four men is required to operate each machine. However, the company also maintains a small crew of relief men owing to the continuous nature of the work.

Scrap loss by the centrifugal process averages well under 5 per cent of the pipe cast. Much of this loss is occasioned from the use of sand cores at the bell end.

Inasmuch as the pipe is cast in a chill mold, it must be annealed before it is ready for service. One furnace constitutes the present annealing equipment. This has capacity for annealing 15 tons or about 65 pipe an hour, which is about 20 to 25 per cent less than the output of the four machines. Therefore, it is necessary to have a night gang anneal part of the production. Work already has been started on the construction of a second annealing furnace and the two furnaces together will anneal the pipe produced by the contemplated plant of 10 centrifugal machines. Annealing simultaneously with the production is desirable, for the heat in the newly produced pipes thus is conserved. In the annealing oven the temperature of the pipe is brought to 1750 degrees Fahr. While at this temperature, they are kept revolving to keep them from bending. After having been brought to this temperature they are passed through a cooling chamber where the pipe also are kept revolving. Here the temperature is reduced to 600 degrees Fahr. after which the pipe are passed into the air.

An important feature of the annealing furnace is that it is equipped with a scale as shown in Fig. 9. Before the pipe are rolled into the furnace, they are weighed. If they are under weight or over weight, the machine operators immediately are informed so that they may adjust the peripheral and other speeds to obtain the desired wall thickness.

Centrifugally cast pipe is said to develop a high tensile strength, and to resist a high interior pressure. The standard specifications for 6-inch, class B pipe call for a wall thickness of 0.48 inch and a working pressure of 86 pounds per square inch. Specifications proposed for the centrifugally cast pipe require a wall thickness of 0.35 inch and the pipe is intended to resist an internal pressure of 150 pounds per square inch. The specifications also call for a brinell hardness not to exceed 224, while laboratory tests have shown an average of 134 for the inside and 171 for the outside surface of the centrifugal product. The patents on the method are controlled by the Centrifugal Pipe Co., New York, and companies making this type pipe are operating on a royalty basis.

Note Foundry Conditions in the Orient

J. W. Gardner of the Gardner Governor Co., Quincy, Ill., who recently returned from an extended business trip in the Orient, at the request of THE FOUNDRY has written the following interesting letter giving side lights on foundry conditions in the Far East.

"On this particular trip my time was spent entirely in the Orient where there is practically no manufacturing. The foundries that are in existence are principally for repair work and do a small amount of jobbing. Their equipment is obsolete. The management is English, employing native help entirely. Wages of the molders are from 50 cents to $1.00 gold per day. The character of the work which is turned out is excellent but the quantity produced is extremely low.

"The foundries in India present a strange appearance for even the small castings are bedded in the floor, and the molders insist on working in a squatting posture instead of at a bench. Furthermore they all go bare footed, even when pouring off. The tendency of all Orientals to assist their hands with their feet is marked, particularly so in the pattern shop. I have noticed patternmakers sitting on their benches and using their feet as well as their hands to accomplish the work. I was particularly interested in one patternmaker carving an intricate piece, holding the work with his toes. Every moment I expected to see him pare off his big toe with a chisel. The tendency to squat at work was exemplified by the foundry laborers who laid their castings on the ground in a little depression and proceeded to chip off the fins.

Labor Cost Small

"In one shipyard which I visited in China I was shown through by a young Chinaman who had been educated in America and spoke English fluently. I asked him about their cost accounting system and he explained that their cost system was not accurate but it fitted their requirements. He said the labor is not figured but estimated as it is such a small part of the cost, but the cost of the material and the overhead is carefully figured. The overhead includes a big item of expense in obtaining orders in the shape of gratuities to the buyer, not only to the head men but also to the staff of assistants. This practice sometimes referred to as the Chinese squeeze evidently dates back for centuries. It may be seen from this that costs in China are quite a different problem than they are with us.

"Industry all through the Orient, as a rule, is carried on in small establishments in which not only the proprietors but the workmen also live. Their work is a given task and when that is accomplished they *knock off* work for the day. It is odd to enter a shop with a large portion of the workmen busy at work while others who have finished their tasks for the day are lying asleep or smoking on their benches or near the machines which they operate. There are some large, modern industries in cotton, jute and silk mills but nearly every other line of manufacture is carried on as I have stated."

The temporary branch office of the Whiting Corp., Harvey, Ill., has been discontinued and permanent offices have been established at 1702 Jefferson County Bank building, Birmingham, Ala.

Controlling Structure of Iron

Theory Built on Moissan's Work on Carbon in Pig Iron Shows Amount of Carbon as Well as Characteristics of Graphite To Be Functions Chiefly of Time and Temperature

BY E. ADAMSON

IN A modern blast furnace the reduction of the ore to pig iron is a function of the temperature, but this statement of fact cannot be carried further because the higher the temperature at which the furnace is worked, the higher the total carbon, the higher the percentage of graphite, the larger the size of the graphite flakes and the lower the combined carbon and its ratio to graphite. Also, on the same burden the higher the temperature the higher the percentage of silicon reduced from the ore, the higher the percentage of manganese reduced from the ore, and the lower the sulphur.

Carbon is the element which controls the molecular physics of the cast iron as disclosed by the fracture. It would seem, however, that the temperature also controls the percentage of the silicon, sulphur and manganese in the pig iron. In 1906 the author stated that the precipitation of graphite is a function of the temperature, and quoted Moissan with regard to graphite. Again in 1912 at the International Congress for Testing Materials at New York, he stated that carbon is the real controlling factor of pig iron and is itself controlled entirely outside of chemical composition by temperature, and by methods of manufacture, otherwise by physics.

The keystone work on carbon by Moissan does not appear to be well known. He produced graphite in contact with metals at varying temperatures, the most important so far as we are concerned being iron. His work in several respects confirms the work of others such as Le Chatelier and Luzi. The following are some of his conclusions:

1. The stability of graphite in contact with metals particularly iron, increases with the temperature to which it has been subjected.

2. A simple rise in temperature caused graphite to be less easily attacked by oxidizing agents.

3. All graphites produced at high temperatures by dissolving carbon in a given metal swell under the action of concentrated nitric acid.

4. This swelling is proportional to the temperature to which the graphite has been subjected.

5. The swelling action takes place at a temperature which varies between 165 and 175 degrees Cent., even in vacuo.

6. Moissan states that one is led to look for a crystallization of carbon in the molten iron under pressure as on sudden cooling the iron contracts violently and the carbon passes from a density of 2 to a density of 3.5.

7. As far as silicon is concerned, no research has been systematically prosecuted and the action of silicon in cast iron has not been clearly determined.

8. Iron dissolves a considerable quantity of carbon but loses its fluidity and becomes pasty.

From the foregoing statements the following fundamental principles are confirmed in blast furnace practice, but are slightly magnified by the presence of other impurities.

(a) The total carbon in the pig iron is a function chiefly determined by temperature and time.

(b) The different characteristics of free carbon or graphite are also a function chiefly of temperature and time.

(c) The precipitation of free carbon from molten or cooling metal is also a function chiefly of temperature and time.

There are five distinct classifications of fracture produced at different temperatures, namely, mottled, close gray, gray star crystal, gray open No. 1 fracture and silky. With the first and last we are not concerned particularly and of the gray fractures the close gray is produced under low temperature conditions, the star crystal at medium and the open gray at high temperatures. For the purpose of easy illustration they are shown in Fig 2.

Fig. 1 (left) shows an unetched specimen indicating a star crystallization of graphite. Incidentally when you see what are known as graphite flakes under the microscope, it is really only empty hollows indicating where the free carbon possibly has been.

Probably few founders have had an opportunity of examining the possible crystallization of graphite between the fine or amorphous and the large flake extremes, but the star crystal of graphite to which the writer called attention in 1911 before the British Iron and Steel institute, is an im-

Extracts from a paper read before the West Riding branch of the Institution of British Foundrymen and the West Yorkshire Metallurgical society.

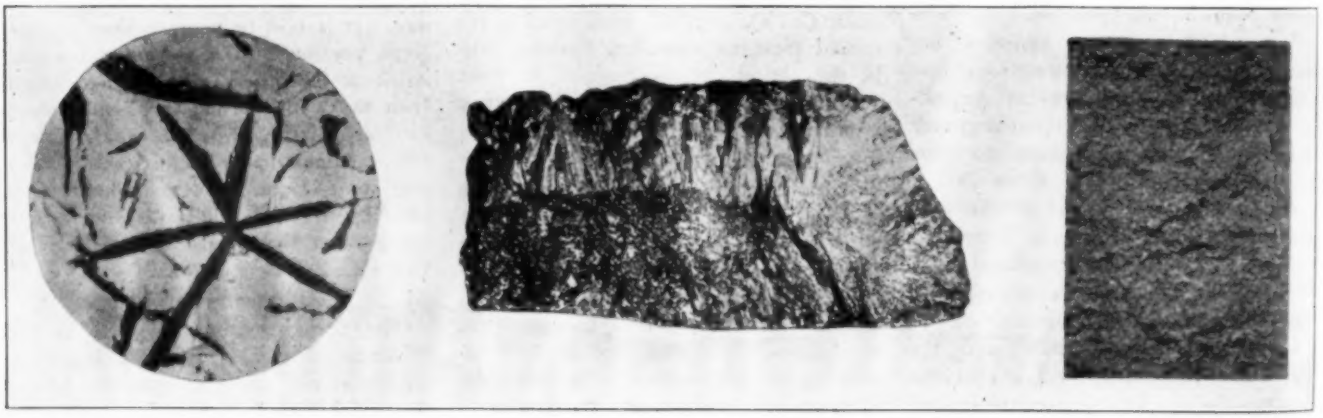


FIG. 1—(LEFT) UNQUENCHED SPECIMEN SHOWING STAR CRYSTALLIZATION OF GRAPHITE. (CENTER) ELECTRICALLY PRODUCED PIG IRON SHOWING STAR CRYSTALS AFTER BEING CAST INTO A CHILL. (RIGHT) STAR CRYSTALS PRODUCED AFTER COOLING OVER NIGHT UNDER MOLTEN IRON

portant consideration because it is found when iron is produced at medium temperatures. It is also formed under slow cooling conditions and also when iron has cooled rapidly from high temperatures as in the following cases:

1. Slow cooled overnight under molten iron, a white fracture produced star crystals the following morning as shown in Fig. 1 (right.)

2. An electrically produced pig iron as shown in Fig. 1 (center) containing 4.28 per cent total carbon, 0.28 per cent silicon, 0.05 per cent sulphur, 0.009 per cent phosphorus and 1.72 per cent manganese cast into a chill showed a star crystal even in the face of the chill, theoretically an impossibility.

Moissan and other scientists claim several forms of free carbon such as temper carbon, amorphous carbon, graphite, etc. From one of his experiments Moissan concludes that the alterations in the character of amorphous carbon to graphite is a question of temperature, and he wonders if amorphous carbon can be produced from the refractory graphite formed as a function of temperature.

Characteristics Persist

The conclusion to which the author has come in connection with the use of pig iron in the foundry is that once graphite is formed at a high temperature in the blast furnace its influence remains throughout the foundry operations to the final casting, and can only be materially modified by careful mixing which breaks up the large flakes. For example, assume a No. 1 iron containing 3.50 per cent total carbon, mostly graphite, is mixed with 50 per cent of steel scrap. The average total carbon in the charge will be about 1.75 per cent, but in the molten metal in the ladle there will be 3.00 to 3.25 per cent total carbon. Therefore, between 1.25 and 1.50 per cent of carbon has been picked up in the cupola at a much lower temperature than that at which the original graphite in the pig iron was formed.

The probabilities, based on actual experience, are that the characteristics of this high temperature graphite will be shown by the metal in the ladle if cast into a test bar, containing a large quantity of the star crystal graphite along with the smaller form of free carbon. In other words, from 1.50 to 1.75 per cent of high temperature graphite is not sufficient to separate out in the cold metal in its original large flake form, even when assisted by the remaining 1.25 to 1.50 per cent low temperature graphite which has been picked up in the cupola. On the other hand, unless suitable means are taken for destroying the influence of the large flake graphite the whole of the carbon will not go into solution on remelting the iron and the cooling metal, therefore, will begin to solidify at a higher temperature, which will not conform to the phase rule of the iron-carbon diagram. This latter statement it is feared will not be accepted generally, but Dr. Carpenter in the discussion on my 1911 paper agreed that the phase rule relating to solidification always could not be applied to works practice.

Moissan looked for crystallization of carbon in molten iron but states that between 1100 and 3000 degrees Cent., molten iron behaves as a solvent, dissolving more carbon as the temperature rises, as he found that when cooled between 1700 and 1100 degrees Cent., the iron gives off a quantity of crystal graphite. The author, however, considers from Ruff and Goecke's experiments on the saturation of carbon and iron, which confirm his own works observations, that it is more probable that Moissan's views in this respect are correct up to a given maximum temperature, but beyond that temperature the character of the graphite formed will be such as will not go into solution, otherwise how could diamonds be formed, and graphite on rapid cooling?

May Use Phase Rule

If the carbon in the materials used in the foundry is in such condition to be taken up in solution, the phase rule modified, of course, by other impurities present, will apply and the molten metal will solidify at the lowest possible temperature. However, if the carbon is in such condition as will not all go into solution, then the phase rule cannot be applied to cooling except to that percentage of carbon which is in solution as shown by the two cooling curves.

Keep Total Carbon Low

Before leaving the discussion of the saturation of carbon and iron, which has a great influence on the structure of cast iron, it might be well incidentally to state when using pig iron produced in the blast furnace it is advisable to keep the total carbon as low as possible, although it may not be known that this is done to make sure that all the carbon is in solution. The other reason for doing this as is well known, is that the lower the total carbon the slower the separation of graphite and its growth to the flake, which assists in giving close grain and a slightly higher test. But it is not wise to argue, because of this fact, that high total carbon will not give high strength tests, for in an electrically produced pig iron with total carbon nearly 4 per cent and silicon about 2½ per cent tests have been shown giving 44,800 pounds per square inch tensile and over 4480 pounds transverse on a bar 1 x 1 x 12 inches. The specific gravity of this metal was 7.35 which suggests an intensely close fracture. Quite recently also a piece of Swedish iron has come into the writer's possession with a total carbon of 4.63 per cent and silicon about 0.60 per cent, and although the slabs were barely 2 inches thick they were most difficult to break with an ordinary sledge hammer. The first of these was electrically produced and the second may have been also.

The true saturation point of carbon in iron is difficult to determine, certainly it considerably exceeds the eutectic of 4.25 per cent, which, as

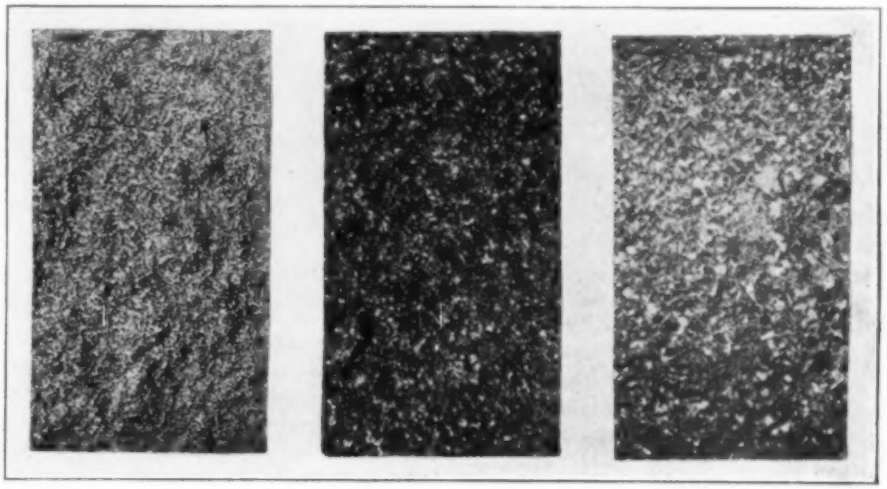


FIG. 2—THREE TYPES OF GRAY FRACTURES. (LEFT) CLOSE GRAY. (CENTER) STAR GRAY. (RIGHT) OPEN OR FLAKE GRAY

already stated, has been looked upon as the saturation point.

As early as 1846 Karsten found iron could take up carbon to the extent of 5.93 per cent and later Moissan found the figure to be 6.76 per cent using electric furnace metal; Foster obtained 4.66 per cent also with electric furnace metal; Sanister got 4.83 per cent; and Girod 8 per cent with electric furnace iron; while Ruff and Goecke found the figure to be 9.64 per cent. Quite recently there has come into my possession a piece of common foundry pig iron containing 4.50 per cent total carbon and 4.83 per cent silicon, both of which figures have been checked three times. The fracture indicates a gray open No. 1 iron. Had the saturation percentage of iron and carbon been 4.25 per cent modified by other impurities present this pig should have had 2.30 per cent total carbon or about half the actual percentage.

Carbon Difficult To Control

Of course, these results are not usual, but we are discussing the possible actual saturation and these examples are used to illustrate how impossible it is to control carbon in the blast furnace. In an investigation a number of years ago, the author came across castings containing 4.50 per cent total carbon while the irons charged on the cupola were only 3.00 per cent total carbon.

To illustrate the difficulty of fixing a definite saturation point for iron and carbon in a simple practical manner, the following experiments were carried out by Saniter in 1897. At 1400 degrees Cent. in three hours he obtained 4.03 per cent total carbon; in 4½ hours 4.81 per cent. The metal was kept molten for 5¾ hours at 1400 degrees Cent. with the result that not only the total carbon was increased but also the graphite, the combined carbon being lowered while the metal was molten. Results of Saniter's test are as follows:

	3 hours	4½ hours	5¾ hours
Total carbon	4.03	4.81	4.73
Graphitic carbon separation	3.00	3.84	3.03
Combined carbon (by difference)	1.03	0.97	0.70
Silicon	0.024	0.04	0.07
Other impurities	...	...	0.005

These variations are a function of time. In this particular instance the silicon was negligible, but it leads to the assumption that had it been 1 per cent or upwards the ratio of increase of graphite and decrease of combined carbon would have been greater as a function of temperature and time. One of the lessons to be drawn from these experiments for the foundry is in the case of a large casting of say 20 tons with a cupola melting capacity of 6 or 7 tons per hour. Under these circumstances it is necessary to keep the metal in the first ladle molten for over 2½ hours and in the second for say 1½ hours, during which time not only is carbon being precipitated but the graphite is growing in size. This is further accentuated by the fact that it is necessary to cover the surface of the molten metal in the ladle with carbonaceous matter which tends to increase the total carbon of the metal and has the further effect of increasing the growth of graphite in both the first and second ladles so that when the metal finally is cast the writer has known the combined carbon in the casting, even in a thin section, to show only a trace, although steel was used in the mixture. The only reasonable explanation is the separation of graphite in the ladle while waiting the full quantity of metal being poured.

Metallurgists wisely are beginning to look first to structure for tests rather than to chemical composition. Smalley in a happy phrase speaks of "grain refining," which refers to the physical side of cast iron and helps us to understand why tests are higher with fine graphite. Structure itself is subdivided for in addition to the varying percentages of impurities even a fine structure may be what the practical man calls "dry" and not, therefore, as strong as another iron of apparently the same structure. This condition again appears to be physical for this "dryness" of fracture can be overcome by the addition of a small quantity of rich "kishy" iron.

To sum up there is no doubt that the structure of the pig iron is controlled primarily by the temperature at which the iron was produced and that a secondary influence on the structure is mass. But primarily temperatures are of greatest importance.

Outline Year's Program

The board of directors of the Quad City Foundryman's association, Moline, Ill., at a meeting held recently decided on the schedule of the subjects to be considered during the coming year. Prominent men in the industry have consented to appear on the programs and present prospects indicate that the coming year will prove interesting and instructive to the membership. The first meeting of the year will be held September 17 at the LeClaire Hotel.

Subjects to be covered during the year include, charcoal, coke and pig iron; a comparison of the coke manufactured from eastern and western coal and a discussion of coke made by the by-product and beehive processes; industrial education including apprenticeships; processes of making steel; improved methods of cupola practice; molding sand; costs and methods of determining; malleable iron, including the melting of gray iron in air and electric furnaces. If time permits additional topics will be discussed during the year including piece rates; inspection; safety first methods; annealing of malleable iron; scrap purchasing; chilled work; green sand cores; electric furnaces; molding machines; sand handling machines; centrifugal molding and sand throwing machines.

The board of directors elected at the May meeting for the year includes A. E. Hageboeck, Frank Foundries Corp. Moline, Ill., president; John Bloehn, French & Hecht, Davenport, Iowa, vice president; H. C. Cooper, John Deere Harvester Works, East Moline, Ill., secretary and treasurer. The other members of the board are A. K. Reading, Zimmerman Steel Co., Bettendorf, Ia.; H. A. Soverhill, Davenport Locomotive Works, Davenport Ia.; Leon Mitchell, Rock Island Stove Co., Rock Island, Ill.; Martin Carlson, Barnard & Leas Co., Moline, Ill.; P. T. Bancroft, John Deere Harvester Works, East Moline, Ill.

Holds Fall Meeting

The American Electrochemical society will hold its fall meeting September 27, 28, and 29 at Dayton, Ohio. Members who expect to attend are advised to make their hotel reservations early. The Miami hotel will be the society's headquarters. The program as previously announced will be featured by a symposium by Dr. McRae of the Westinghouse Lamp Co., Bloomfield, N. J., on the electrochemistry of gaseous conduction. The announcement is also made that the forty-fifth meeting of the society will be held April 24, 25 and 26, 1924 at Philadelphia, and the limiting date for the acceptance of papers for this meeting is February 15, 1924. Colin G. Fink, Columbia university, New York, is secretary.

The B. F. Sturtevent Co., Hyde Park, Boston, has arranged to manufacture and sell the direct-fired heater formerly manufactured by Robert Gordon Co., Inc.

Injunctions to restrain the Newport Foundry Co., Frankfort, Ky., from operating at night and on Sundays were overruled recently by Judge Ernest Clarke of the Kentucky court of appeals.

Operate Co-operative Foundry

Small Group of Molders Interest Others in Forming an Enterprise in Which All Share Equally in Labor and Remuneration —Complete Three Years Activity

BY EDWARD H. TINGLEY

WHAT is the factor in business, which if rightly handled, will insure success? It is not large sums of money to invest, extensive buildings, modern equipment with which to work or many orders on the books, but the human element, carefully organized and welded into a working unit, actuated by a willingness to put the good of the company ahead of that of any individual. The keynote of any individual's success is having the right mental attitude toward his work, putting in more than the required eight hours, if necessary and giving his best thought to his task at all times. This basic principle governed the 28 men here shown in the formation of the Superior Castings Co., Dayton, a co-operative gray iron jobbing foundry.

IN THE summer of 1920, five molders met in Dayton, O., and discussed the possibility of entering business together and operating a foundry of their own. At that time business conditions were excellent and there were plenty of orders available. These men studied the various types of business organizations and decided to form a co-operative company. In deciding on this type of organization, they considered several phases which must be adjusted satisfactorily to assure harmony. First, it was decided that all the men who would be asked to join the organization must be expert molders and of a type that co-operates and works with the others without friction. Second, no stockholder was allotted more shares than any other. This kept all on an equal basis and gave each equal voting power. Third, every stockholder receives equal wages no matter whether he is president, superintendent or cupola tender. Fourth, a president, a vice president and superintendent and a secretary and treasurer, together with several others were elected by the stockholders as a board of directors who guide the company's affairs. The president was designated the outside man who would get the business and make the estimates on new work. The superintendent manages the foundry and the secretary handles all the cost keeping and accounting records.

The board of directors, having control of the policies of the company, necessarily sets the wages paid, approves all extensions to the business or the purchase of new equipment and decides what dividends are paid on the stock outstanding, after setting aside a reserve for depreciation, repairs, etc.

The elements of organization enumerated above were incorporated into a constitution and by-laws and the five organizers believed they had adjusted all the fundamentals that could give them ultimate success. Confident of this, they went among their friends and offered an interest in the enterprise to certain picked men, well known for their ability as molders and for their honesty and industry. In a short time, the list of stockholders totaled 29, and it was decided that this number was sufficient to begin business. In selecting the stockholders, the entire organization of a foundry was covered. For example, the secretary and treasurer chosen possessed bookkeeping and accounting experience.

The accompanying illustration shows the original stockholders with the exception of one who died.

By the time the organization was completed and the stockholders had paid the amount allotted for their stock, the business depression was encountered. However, the men were confident of the future and proceeded to incorporate the business in February, 1921, as the Superior Casting Co.

As all of the stockholders at that time were unemployed, they proceeded to purchase a plot of ground and erect their own building. They did all the labor themselves from mixing concrete, carpenter work, putting on the roof, to building their own cupola. They bor-

rowed the patterns of the cupola base and legs and molded the castings in another foundry where some of the men had previously worked. The cupola shell and stack were made by a boiler shop, but the stockholders erected it. They lined it with brick and set up and connected the blower. They then purchased and unloaded their first carloads of sand, coke and pig iron, working many days for 14 to 15 hours.

The first foundry had a floor space of 4800 square feet not counting the wing in which the cupola was placed. The cupola was located so as to be in the center of the foundry when extensions were made.

Business was hard to secure during 1921, but with a strong confidence in the future, the board of directors authorized the extension of 2400 square feet which was completed before the end of 1921. Increasing business in 1922 made it necessary to add 4000 square feet more which soon proved inadequate. The beginning of 1923 saw the opening of a new wing of the main building which added 10,000 square feet more to the total floor space. With 21,200 square feet of space now nearly filled, and with modern equipment installed, the estimated value of the foundry is $100,000.

Some of the interesting problems were encountered in managing this co-operative organization.

The estimating on new work is handled by the president who, as was noted, is appointed to get work and keep the foundry busy. He figures the probable cost and after the order is run, he checks up the actual costs. The costs are compiled from the invoices for materials and supplies, from time tickets made out by the molders and from the payroll. The interest on the borrowed capital also is included. The secretary keeps all the books, gathers the cost figures and makes out the payroll. Every month an average cost per pound is computed for all iron melted which gives a basis for checking estimates.

Once every three months the books of the company are audited by a certified public accountant and the figures are checked. This shows the stockholders what profits are being made and satisfies the bank when it is necessary to secure loans. This audit also provides a check on the ability of the president to secure orders with the necessary margin of profit.

Labor turnover in the early days was nothing as only stockholders did the work. At that time they unloaded cars of sand and coke, charged the cupola, made the molds and cores, cleaned the castings, and did everything that was to be done. There was no limit to the hours they worked and sometimes now they spend 12 to 14 hours a day in the foundry. As business increased outside molders were hired and the force has been considerably increased until today there are about 130 molders employed. Turnover is kept to a minimum as the stockholders are working among the men, entering into all the conversation and arguments and they can settle any grievance the workmen may have. Troubles are taken up promptly with the superintendent and adjusted.

The quality of the product is the main selling argument for any foundry. Therefore, the Superior Casting Co. endeavors at all times to make the best castings possible. The stockholders realize that the smaller amounts of scrap due to foundry troubles in the machine shops where their castings are machined, the more business they will get. They also realize that the smaller amount of scrap run in their own foundry, the cheaper the unit costs and the more profit to be secured. So every effort is made to make soft machinable castings—with the minimum loss.

Naturally in the early days all the income received went to pay the expenses. For seven months all the men never drew a cent of wages and still they were confident that profits would come in the future. Today all the stockholders outside molders and officials are drawing equal pay, but the profit on the common stock adds considerable to the income of the stockholders and recompenses them for their previous sacrifice.

Consolidate Interests

The Arcade Malleable Iron Co. division of the Baldwin Chain & Mfg. Co., Worcester, Mass., and the Springfield Malleable Iron Co., Springfield, Mass., owned by the same interests, are to be consolidated in a new company under the name of the Arcade Malleable Iron Co., with headquarters in Worcester.

Henry P. Blumenauer, vice president of the Baldwin Chain & Mfg. Co., and general manager of both subsidiaries, will be president of the new company, retaining the former position. Among the directors of the new company will be Frank J. Weschler, president of the Hendee Mfg. Co., and John N. Collins, vice president of the Moore Drop Forging Co., both of Springfield, and J. Verner Critchley, president of the Reed-Prentice Co., Worcester.

Castings Exports Steady

The foreign trade in castings was heavier in May and June than in the earlier part of the current year. The tonnage in May was 17 per cent heavier than the average for the first half of 1923, and in June it increased to 23 per cent. The export tion of iron castings increased 82 per cent from May to June, while the exportation of steel castings fell 37 per cent during the same month. Although the exportation of iron castings increased from May to June, and that of steel castings decreased, the increase and decrease practically balanced each other, so that the increase in exported tonnage amounted only to 5 per cent from May to June. The ratio of imports to exports for the latter part of the first half of 1923 averaged 25 per cent. However, the average ratio for the period from January to June was only 19 per cent.

A. F. A. To Dispense Fund

The fund of $500 which was to have been used by Rogers, Brown & Co., Cincinnati, as prizes for new ideas for uses of cast iron, has been turned over to the American Foundrymen's association for its disposal. The judges of the contest, Enrique Touceda, George Smart and John A. Penton, after receiving the suggestions, submitted in this competition, decided that, in their judgment, no one of the competing recommendations was of sufficient value to justify an award being made. The committee then suggested that the total amount of the proposed awards be placed at the disposal of the American Foundrymen's association to be used in any way thought best for any purpose connected with the gray iron industry from a research standpoint. By this means the committee considered that the principal object of the contest, that is, the extension of the usefulness of the gray iron industry, would be attained.

Remove Plant To Indiana

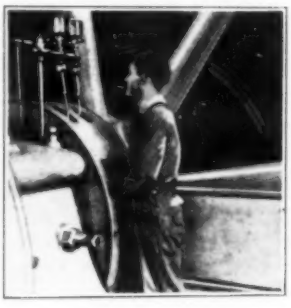
The Sullivan Machinery Co., Chicago, has removed its manufacturing plant to Michigan City, Ind., where operations have been started. The general offices and sales department will be maintained in Chicago, according to an announcement by F. K. Copeland, president of the company. A new foundry is contemplated as an early addition to the facilities at Michigan City.

The National Machine Co., manufacturer of printing presses, textile presses and heaters with factory at Wethersfield, Conn., has disposed of its business to the Thomson-National Press Co., a new corporation with headquarters at East and Nott avenues, Long Island City, N. Y.

Training Foundry Apprentices-II

Education as a Factor in the Development of Valuable Employes Has Been Studied—Classroom Instruction Follows Closely Upon Practical Shop Demonstration

BY H. A. FROMMELT



REPETITION work has been criticised severely for its deadening effect upon human initiative. Men handling only one small detail part in a machine or assembling operation are said to lack the incentive of interest which comes through acquaintance with the finished product or the successive steps by which it grows to completion. In the system described in this and a preceding article, the author, who is superintendent of apprentice training for the Falk Corp., Milwaukee, an effort is made to acquaint the beginner with all phases of the work of which his task is a part. Education, which offers answers to the questions of why and how, is combined with that which answers the ever present but oft unexpressed queries as to whether profits and wages are well balanced.

CENTURIES ago when apprenticeships flourished so strongly in the guilds of the Middle Ages, no attempt was made toward education as we now know it. Industries were confined to the small shop and almost entirely to hand work as distinguished from the machine work of the present day. Boys were apprenticed to the master at an early age. They worked for long years as learners, then became journeymen, that is, they journeyed to various towns and places, acquiring further knowledge and experience. Finally, after making their master-piece they were considered masters. The entire educational process consisted largely in just this kind of apprenticeship. There were no common schools as we know them at present. Young lads were sent to a master of whatever trade they were desirous of learning and with him they lived and worked and were taught. He, the master, undertook their whole education. In other words they were educated while they worked, they learned while they labored with their hands, their workshop became their schoolroom.

Industry Separate Now

Today, education is entirely separated from work. To go to school is one part of our lives, to go to work is an entirely different part. Certain years are set apart for school, at the end of which time we are supposed to enter upon an entirely different career, an entirely different phase of life. There is little or no connection between our educational systems and our workshops, the industries of today.

We cannot return to the old apprenticeship system, and we would not even though we could, but it has become increasingly evident from year to year that a far closer contact between the schools and industries must be established. In some manner we must carry on the educational process started in the schools and make it available in the early years of apprenticeship training. Education must be made a vital part of our modern apprenticeship systems. Time must be set aside for the apprentice in industry in which he is to give himself over to the learning of those things that are necessary to make of himself not only a good craftsman but a good citizen as well.

If the American workman is becoming more and more susceptible to radical doctrine, it is also true that the employers have done little or nothing to bring home to their men fundamental economic facts which would do much to refute all the radical doctrine to which they possibly could be subjected. A manufacturer, in the hearing of the writer, commented unfavorably on the value of the part-time education for apprentices, who are required to attend continuation school for five hours in one week.

"What can they learn in one afternoon each week in class work of that kind?" was asked.

"You fully appreciate what can be done in one evening a month at a radical meeting," was the pointed response.

Unless the manufacturers are careful to lay before their apprentices fundamental economic doctrines that can be substantiated by actual figures they have little reason to complain of the radical tendencies of their workmen.

Other Phases Important

This is but one small, though important, portion of that educational program that can and should be carried on in a modern apprenticeship. Consider the steel foundry industry. Who will deny that there is a great body of facts which the apprentice never can learn simply by working in the foundry? What of the whole subject of heat treating, so vitally important to a good understanding of steel, its characteristics, qualities, properties etc.; what of the important subject of foundry sands, of metallurgy, foundry calculations, layout, equipment and organization? Unless an attempt be made to lay these before the apprentice it will be impossible for him to obtain them in any organized, systematic manner. The whole field is so vast, and yet so interesting that it is impossible to believe that an apprenticeship could be attempted without including at least these fundamentals.

The apprenticeship system adopted by the Falk Corp., Milwaukee, includes a minimum of five hours per week for the study of the so-called related trade technique, English, economics and industrial science. Apprentices are re-

quired by law in the state of Wisconsin to spend five hours per week during the first two years of their apprenticeship in some public school. Courses have been developed for each class of apprentice and so co-ordinated with the work of these public schools that there is little or no duplication. Class-room work becomes a part of the apprenticeships even during the first two years and is extended throughout the four years, the latter half being spent entirely in the company class-room.

There are four main divisions of studies as follows:

Shop mathematics.
Related trade technique.
Physics, chemistry and mechanics.
Economics.

It should be noted here that the absence of English in the above is explained by the fact that while it is not specifically mentioned in this general outline, it is insisted upon in all the class work and reports. Moreover, it is taught, as such, in the continuation school.

Divide the Course

The four main divisions enumerated above appear in detail, with the allotment of hours as follows:

1. SHOP MATHEMATICS

Subject	Hours	Weeks
Fractions	16	8
Decimals	16	8
Percentage and interest	16	8
Ratio and proportion	16	8
Involution and evolution	16	8
Algebra	40	20
Geometry	40	20
Trigonometry	40	20
Formulas	52	26

2. RELATED TRADE TECHNIQUE

Subject	Hours	Weeks
Shop calculations	40	20
Sketching (blue print reading)	30	15
Green sand molding	30	15
Core making	20	10
Machine molding	15	7
Dry sand molding	20	10
Loam and sweep molding	10	5
Foundry appliances	10	5
Steel making	30	15
Steel casting	40	20
Metallurgy	40	20
Foundry materials	40	20
Foundry layout and organization	15	7

3. CHEMISTRY—PHYSICS—MECHANICS
(Industrial Science)

Subject	Hours	Weeks
Chemical symbols, formulas and elementary calculations	12	6
Mechanics	48	24
Sound	12	6
Light and electricity	12	6

4. INDUSTRIAL ECONOMICS

Subject	Hours	Weeks
Production	24	12
Distribution	6	3
Consumption	6	3
Stocks, bonds, etc.	36	18
U. S. Government	12	6

This then represents the basic course and varies in the different divisions, conforming as it does to the shop work of the respective divisions. The others remain the same.

Special Care Shown

This then represents the basic course for all apprentices, the level of attainment for the average apprentice. It presents the fundamentals, the lines along which further study may be pursued. Class work is so apportioned that all apprentices necessarily must spend an equal amount of time in home study. Special courses are arranged where required. Foreigners not well acquainted with the language of our country, boys with more than the average intelligence and ambition as well as university graduates are given special or additional work. In some cases young men who have given promise of foremanship ability have been given an opportunity to pursue studies along production and business organization lines.

ADVANCEMENT IS OFFERED THROUGH SPECIAL TRAINING TO BOYS WHO POSSESS QUALITIES OF FOREMEN

Moreover, the regular routine is at times interrupted to make room for films, slides and lectures. Inspection trips occasionally are made to one or more of the many industrial plants in the Milwaukee district. The company has collected a large number of instructive slides which are used to illustrate certain sections of the related shop technique course. Thus, for example, in the course of metallurgy, illustrated talks are designed to carry the student from the mining of the ore in Minnesota to the finished product through the various stages of pig iron, cast iron, steel, etc. Power plant tests occasionally are made to vary the monotony of apprentice life and at the same time to impart some valuable information regarding power generation in the ordinary industrial plant.

The class-room work at first was conducted in the ordinary group fashion. However, it soon was discovered that a far more effective method consisted in individual instruction. Correspondence schools were appealed to and their co-operation enlisted in this work. Now every apprentice is enrolled in a course suitable to the trade in which he is engaged. Individual help and encouragement is given only when requested and when and where most needed. Thus each apprentice progresses at such speed as is best suited to his own requirements and abilities. The examinations demanded by these courses are written out in the class-room and sent, in the regular fashion, to the correspondence school for correction and approval. The grades thus given are used for the company's records and for awarding prizes mentioned in a previous article.

The educational aspect of a modern apprenticeship as typified in this system meets the difficulty of co-ordinating education and work. The apprentice not only learns a manual operation, but the technique of that manual operation as well—and at the time he is doing it. Thus, for example, while engaged in green sand molding, the related technical information is made available in a systematic orderly fashion. While engaged in work on the open-hearth furnace floor, the making of steel by this method is presented, at least in an elementary manner, and supplemented by slides showing the construction of furnaces, the relationship of this process to other steelmaking processes and to the whole subject of the refinement of iron ore. The same system is followed when considering heat treatment and the making of alloy steels. All the while the final object of the course is firmly kept in mind, namely, that steel molders and not metallurgists are being trained and instructed.

A whole new world is opened up before the inquiring eyes of the young apprentice. He begins to see the sand

pile in terms of *bond* and *refractory;* the liquid, red-hot in terms of carbon, silicon manganese, sulphur and phosphorus; the casting in terms of heads and risers and blowholes and shrinks; the foundry in terms of organized, correlated departments engaged in highly technical processes and turning out a product vitally essential to modern civilization.

But that is not all. When some one whispers to him about the discrepancy between the price of a casting and the wages he is receiving, he is able to resolve the difficulty by applying the magic term over-head. He begins to see the relationship between taxes, insurance, heat, light and power and the final costs. He appreciates that reserve funds are necessary for modern large scale business; that depreciation, sinking funds, bond issues, replacements are terms of vital importance to modern industry. He is a producer of castings and as such need not know these things even in an elementary manner. However, he also is a man, a home owner, a citizen, and as such should and must know the elements, cause and effect that control a manufacturing business. If he does not he offers a fertile field for radical doctrines and destructive economic theories.

Apprenticeship means training and education. If rightly conceived it means the training of competent workmen, satisfied employes and intelligent citizens. The plan as here outlined was designed with that purpose in mind and the results thus far have fulfilled expectations. It is possible that this method will prove the solution.

India Shop Adopts Continuous Molding

IN MANY tropical countries and especially in India, cast-iron railroad ties are used extensively, wooden ties being soon destroyed by the ravages of insects. In other cases concrete ties are used, the rails in these instances being carried on special cast-iron chairs or tie plates.

For making castings of this sort in India, Sharpe & Paterson, Ltd., Glasgow, Scotland, British agents for the Beardsley-Piper Co., Chicago, molding machine manufacturers, have recently designed the layout shown in the accompanying illustration. The castings are to be produced continuously at an estimated rate of two per minute.

The arrangement consists of two stationary machines, manufactured by the Beardsley-Piper Co., mounted over turntables carrying stripping-plate machines. The molds are handled on an endless train of flat top cars which is carried around a narrow-gage track by means of a rope drive, the sand being stored in the middle of the plant as shown in the illustration. As the mold cars pass the station *T*, the drag portion of the empty flask is lifted off by a jib crane and deposited on the stripping-plate machine in position *A* on the turntable. This turntable rotates at about half a revolution per minute in the direction indicated by the arrow. The drag as it passes under the sand throwing head of the machine after which the pattern is drawn at *B* and the finished drag put back on the mold conveyor at *M*.

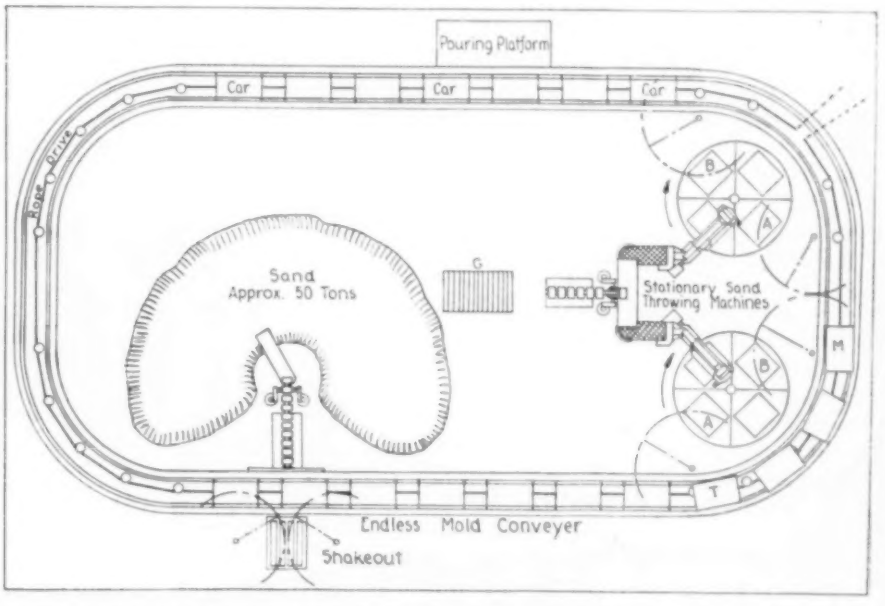
The cores are set as soon as the mold is placed on the conveyor so that by the time it reaches the second turntable it is ready to receive the cope which has been molded with the aid of the second sand throwing machine. After the mold is closed, it proceeds to the pouring platform as shown, thence passing around to the shaking out station. The rope drive operating the mold conveyor moves at the rate of approximately 6 feet per minute.

The castings are shaken out over a grid from which they slide down to a conveyor on which they are carried to the cleaning department.

The used sand passes through a revivifier from which it is discharged into a bucket elevator terminating in a distributing trough placed at a considerable height above the floor. This trough rotates through 180 degrees and piles the sand up in a semicircular heap as shown. About 50 tons of sand are stored in the heap and it has plenty of time to season before it is used again. From the storage heap, the sand is dropped through the grating *G* which connects with the bucket elevator leading to the sand throwing machine.

The rectangle occupied by the endless mold conveyor is approximately 69 feet long and 35 feet wide and it is estimated that about 50 horsepower will be required to drive the plant.

Generally the sand is obtainable from local sources and the labor for this equipment will be recruited from natives whom the company succeeds in training.



COPES AND DRAGS FOR RAILROAD TIES AND TIE PLATES ARE MADE ON STRIPPING PLATES, SAND BEING THROWN INTO THEM BY TWO MACHINES—AN ENDLESS CONVEYOR CARRIES THE MOLD TO THE POURING STATION AND THEN TO THE SHAKEOUT FLOOR

Melts Nonferrous Metals

At the National Exposition of the Chemical Industry, New York, Sept. 17 to 22, the General Electric Co., Schenectady, N. Y., will exhibit an operating model of its new electric induction furnace for melting nonferrous metals. The purpose of the furnace is to secure heat sufficient to melt nonferrous metals without permitting any products of combustion to enter the molten bath. Other apparatus to be displayed includes an automatic arc welding machine which also will be in operation, demonstrating shaft and straight seam welding on a small lathe.

Heat Treat To Improve Castings

Tests Show That Chrome-Nickel Steel and Other Castings Have Been Improved by Heat Treatment Which Shows Up Defects in Design— More Research in This Field Is Needed

BY A. W. LORENZ

HEAT treatment of steel castings is no longer a matter of curiosity and speculation, but is a practice well established in many of our leading industries. Strange to say, it is a matter which has not been taken up seriously by foundrymen in general, possibly because they do not as a rule have either the equipment or personnel for such work. The development of heat treated castings has been confined almost entirely to those manufacturers who, by reason of their experience in the treatment of forge and tool steels, are in a position to handle castings as well. The ideal condition should exist, however, when the foundry is equipped to deliver fully treated castings, for while heat treatment alone produces a certain amount of improvement, the best results can be obtained only when foundry practice ties in with it.

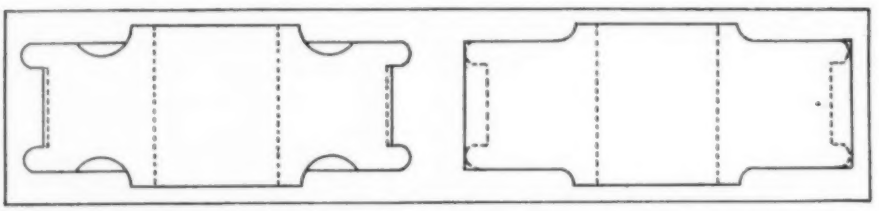


FIG. 1—ROLLER CASTING REDESIGNED TO PERMIT OF EASIER AND BETTER FOUNDRY PRACTICE. THE SKETCH AT THE RIGHT SHOWS THE PATTERN AS ALTERED

A simple explanation for this is that heat treatment exaggerates to a remarkable degree the virtues and failings of the steel itself. One investigator has expressed the opinion that the heat treatment of steel castings will bring on a new era in foundry practice, focusing attention on conditions heretofore considered of little moment, and calling for higher standard of quality. It is not the purpose of this article to go into details on such points, but we shall enumerate briefly some of the defects which are becoming apparent to the treater of castings.

Nonmetallic inclusions have been thoroughly discussed by various writers. Possibly, however, too much attention has been focused on the contained or selfgenerated impurities of the steel itself, such as manganese sulphide, alumina, etc., and not enough thought has been given to the inclusions picked up in the mold. Excess silica wash, drops and breaks due to poor ramming, or dirt carelessly left in the mold, are the most harmful elements imaginable in a piece of steel. Such impurities form a film between the crystals, and no amount of treatment can remove the outline of the original structure. Surface inspection of a casting may be a better criterion of quality than many a phyisical test.

Dendritic structure is sometimes so pronounced that the most careful treatment will not remove it. This structure is held to be due, as one investigator states it, to the temperature gradient between the center and surface of the mold. It therefore involves a study of pouring temperatures, mold temperatures, size of casting, and all other conditions affecting the rate of cooling.

Concerning the density of steel it is the usual thing for us to think of a casting as being either sound or porous; solid, or possessed of shrinkage cavities. These are conditions which we can see. However, it seems evident that the soundness of steel may run the gamut between apparent porosity down to a degree which may be indicated merely by a lack of density, and which can only be brought out by macroscopic or microscopic examination.

Practical Examples

For several years we have been heat treating 0.50 to 0.60 carbon rollers, as shown in Fig. 1, to obtain a surface hardness of 400 to 450 Brinell. When cast in the form shown at the left, about 2 per cent cracked in the flanges during or after quenching, due to sand inclusions. The pattern was altered to the form shown at the right to permit of easier and better foundry practice. Out of several thousand made to the new design, none has been lost in heat treatment.

Fig. 2, left, shows a nickel-chrome pinion weighing about 400 pounds. On account of the exacting nature of the service for which this pinion was intended, a sample was cut up after treatment. A slice was examined microscopically and indicated lack of density at the root of the teeth. This conclusion was confirmed by the results shown in Table I.

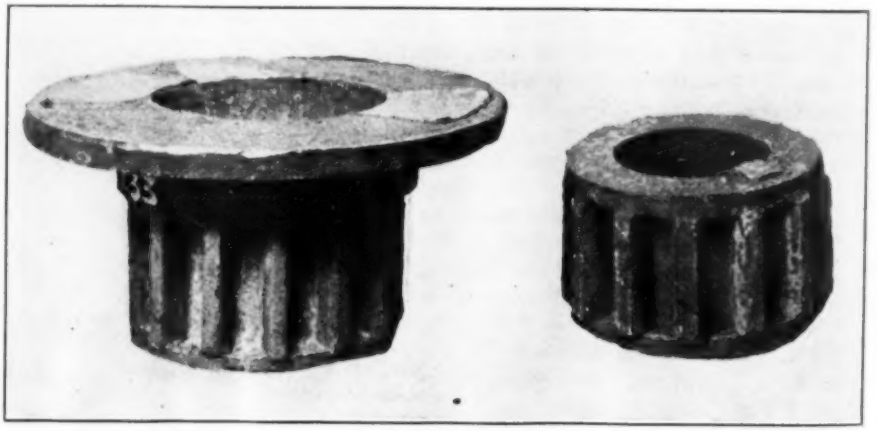


FIG. 2—PINION CASTING CHANGED IN DESIGN TO OBTAIN A DENSE METAL AT THE ROOT OF THE TEETH

The part was redesigned, making the flange a separate unit. It was thus possible to get a more direct feed to

From a paper presented at the Cleveland convention of the American Foundrymen's association. The author is connected with the Bucyrus Co., South Milwaukee, Wis.

the roots of the teeth. Heat treated pinions of the new design, as shown in Fig. 2, right, have been in service for several years, and are reported by the users to be giving excellent results. The treatment of castings, as has often been stated, is in every way similar to the treatment of other types of steel. Literature on this subject is so easily obtainable, and the art is so well standardized, that a detailed discussion is hardly necessary. With proper furnaces and equipment, and careful heating, no trouble will be experienced from cracking and warping, unless on intricate pieces. While oil is probably the most satisfactory quenching medium for small work, water is more adaptable for large pieces. The water should be kept warm, at least 70 degrees Fahr. Several companies treating large quantities of castings quench in water at 125 to 150 degrees Fahr., and the results are satisfactory. The castings should not be left in until cold, but for a definite period, determined by the point when the piece no longer kicks.

On removal from the water, the piece should be immediately drawn. Cracking is likely to result on long standing. It has been rather definitely established that certain types of low carbon alloy steels give better impact values if quenched from the draw, instead of cooling in the furnace. In such a case, a final heating at a still lower temperature is advisable.

Develops Wearing Qualities

The steel about to be described is intended to develop wearing qualities as well as strength. It is a type frequently demanded by the Panama Canal commission under the following specification: Nickel 1.50 to 1.75 per cent, reduction of area 15.0 per cent. This steel, in the annealed condition, generally will average about 60,000 pounds per square inch yield point or higher, 100,000 pounds per square inch ultimate strength, 15 per cent elongation, and 20 per cent reduction in area. Occasional bars will show as high as 70,000 to 75,000 pounds per square inch yield point, 110,000 to 120,000 pounds per square inch ultimate strength, 20 to 30 per cent elongation, and 30 to 50 per cent reduction in area. When heat treated, test bars of a 0.35 per cent carbon nickel-chrome steel show the results in Table II.

As the carbon content increases, the added brittleness of the steel becomes quite noticeable, and the presence of even small amounts of impurities has a marked effect on the ductility. For this reason, results on different heats, or even on various bars from the same heat may not always be concordant.

Table I

Physical Properties of Nickel-Chrome Steel

	Yield point, pounds per square inch	Ultimate strength, pounds per square inch	Elongation, per cent	Reduction of area, per cent
Test bar	92,450	111,500	19.5	50.0
Flange	86,300	113,700	15.0	19.1
Root of teeth	79,750	104,800	8.5	8.5

Table II

Tests of 0.35 Carbon, Nickel-Chrome Steel

Carbon, per cent	Manganese, per cent	Nickel, per cent	Chromium, per cent	Phosphorus, per cent	Silicon, per cent	Sulphur, per cent
0.35	0.82	1.95	0.66	0.011	0.36	0.022

Treatment	Yield point, pounds square inch	Ultimate strength, pounds square inch	Elongation, per cent	Reduction of area, per cent	Brinell hardness	Izod
*WQ 1500, D 1200	113,300	130,000	14.5	29.5	269	31
Air cooled	75,000	104,750	21	48.3	..	..
Furnace cool from draw.	92,650	105,800	23.5	52.0	248	37
*WQ 1500, D1150 Furnace cool from draw.	91,700	105,750	23.0	52.0	248	..
*WQ 1500, D1150 Quench from draw	89,000	107,000	21.0	51.1	255	44
Quench from draw	89.500	107,050	23.5	53.9	255	..

*WQ, water quench; D, draw.

Table III

Tests of 0.40 Carbon, Nickel-Chrome Steel

Carbon, per cent	Manganese, per cent	Nickel, per cent	Chromium, per cent	Phosphorus, per cent	Silicon, per cent	Sulphur, per cent
0.40	0.84	1.72	0.63	0.11	0.42	0.032

Treatment	Yield point, pounds square inch	Ultimate strength, pounds square inch	Elongation, per cent	Reduction of area, per cent	Brinell hardness	Izod
Air cooled, D 1150	64,050	114,000	15	24	241	6
*WQ 1500, D 1200	113,300	130,000	14.5	29.5	269	31
WQ 1500, D 1200	79,300	109,300	16.0	37.9	..	..

*WQ, water quench; D, draw.

Table IV

Tests of 0.45 Carbon, Nickel-Chrome Steel

Carbon, per cent	Manganese, per cent	Nickel, per cent	Chromium, per cent	Phosphorus, per cent	Silicon, per cent	Sulphur, per cent
0.46	0.87	1.87	0.83	0.016	0.44	0.038

Treatment	Yield point, pounds square inch	Ultimate strength, pounds square inch	Elongation, per cent	Reduction of area, per cent	Brinell hardness	Izod
Air cooled, D 1200	68,500	109,450	19	27.8	241	6
*WQ 1500, D 1200	119,850	139,000	13.5	23.7	269	26
WQ 1500, D 1200	106,700	120,250	17.5	35.7	..	..

Table V

Effect of Adding 0.4 Per Cent Molybdenum

Treatment	Yield point, pounds square inch	Ultimate strength, pounds square inch	Elongation, per cent	Reduction of area, per cent	Brinell hardness	Izod
Air cooled	130,000	162,400	3.5	3.9	450	..
Furnace cooled	104,000	140,400	13.0	24.4	302	6
Air cooled, D 1250	90,000	119,450	17.0	25.1	262	27
Furnace cooled, D 1250	60,150	101,100	17.5	33.7	212	11

*WQ, water quench; D, draw.

Tables III and IV show results on 0.40 and 0.45 per cent carbon nickel-chrome steel, respectively. The addition of about 0.4 per cent molybdenum to the above steel produces some interesting results. The general characteristics of such a steel, with 0.35 to 0.40 per cent carbon, are shown in Table V. This steel is extremely sensitive to changes in the rate of cooling, and is not satisfactory for quenching. The upper critical point occurs at about 1350 degrees Fahr., but greater hardness can be obtained by heating to higher temperatures.

Our experience in the manufacture of alloy castings has been confined almost entirely to chrome-nickel steel. Over a period of many years, we have found this type most adaptable for our class of work. The demand for special steels is rapidly increasing, and it is well worth the founder's time to investigate the problems involved.

Size of Furnace Affects Costs

Conditions Which Govern Selection of Size of Furnace Are Considered and Operating Costs Are Given for Large and Small Installations Based on Output —Little Difference Is Found in Costs Per Ton

BY LARRY J. BARTON

THE question whether the small electric furnace is a commercial success in the steel foundry is difficult to answer. On first sight it would appear that the advantage would lie with the larger size furnaces, due to their ability to handle a larger tonnage over a given period. When all of the points are considered it appears that this advantage is little, if any. In fact, it is the writer's opinion that the shop employing the small furnace has a distinct advantage in the great majority of cases provided careful management is employed. By small furnaces are meant those of from ½ to 1-ton rated capacity; large furnaces of from 3 to 5 tons each, sizes larger than this being infrequently found in casting work. So many variables enter into the calculation of this problem that it becomes difficult for one to say with great accuracy that a 1-ton furnace will prove superior to one of 3-ton capacity.

In deciding upon the furnace to install two main features must be considered; namely, the maximum size of castings to be made, and the tonnage to be handled over a given time. If castings weighing over 3 tons frequently are to be made, the larger furnace will be mandatory. Similarly if the company has an assured tonnage sufficient to operate the large furnace to capacity it would be out of the question to even think of a small-sized unit. However, most companies are not in such a fortunate position, and are dependent upon general jobbing castings for their orders. Some are more fortunate in that a part of their output can be used in manufacturing castings for their own lines. For these classes of manufacturers there is no question but that the smaller unit will prove more suitable, for the following reasons:

It is much easier to obtain the tonnage necessary for the economical operation of the small furnace than it is for the larger installation.

It has been found in actual practice that of the work handled in a 3-ton furnace from 80 to 90 per cent could be cast from a small furnace.

On classes of work too large for the small furnace there is the added competition offered by the large open-hearth shop, always eager to bid on tonnage work.

The power demand is much smaller. During slack times when the furnace is not in steady operation this means a saving in fixed charges of from $500 to $1000 per month, depending upon the power schedule.

Primary Outlay Low

Naturally the primary outlay will be much smaller for the shop installing a 1-ton furnace. The building will not need so much floor space due to the fact that smaller heats are poured at shorter intervals. Also the building and crane runways can be built much lighter.

Clarifies Cost Finding

Varied circumstances have such a marked effect on costs that it is impossible to make a hypothetical case which will favor one method of operation in contradistinction to another. In the case considered in this article it appears that the advantage is on the side of the furnace with a small capacity. In some circumstances this would not be true. But, if conclusions in all cases cannot be drawn from the final statements of the article, it is, nevertheless, valuable in giving one a method of figuring a comparison using his own conditions. The steps are simplified and made clear so that they are easy to follow, and unessential details which would make the comparison unnecessarily complex are omitted from consideration.

The size of auxiliary equipment such as ladles, sand mixers, mold-drying ovens, core ovens and annealing ovens are much smaller. Also the quantity of flasks needed is much less, due to the greater turnover. Many other points exist which are indirectly in favor of the small unit. For further calculations we will assume that the cost of these items is directly in proportion to the size of melting equipment.

An important factor in an electric furnace shop is to be able to run continuously, if possible, in order to conserve the heat left in the furnace from the prior melt. For this the small unit is supreme. As heats of 1000 pounds can be made it becomes easy to keep the furnace in operation by working on different classes of metal. Common steel castings can be made as the main product, and orders for small lots of special metal such as chrome, nickel, or manganese steel can be taken and filled with a profit Under these conditions of operation the cost of conversion becomes low, and if there is a fair power charge gray and white-iron castings can be made cheaper than in the cupola. Operating in this manner the furnace is always kept busy and cheap operating costs are secured.

The question, how can the shop with the small tonnage attract and hold the high priced man, at first glance seems to offer a problem. In the 3-ton shop there necessarily will be a superintendent at about $5000 a year, a melter, a foundry foreman, and a cleaning room foreman each at $3000 a year. In the small shop it is naturally impossible to have on hand such an array of talent. The solution is therefore to obtain for superintendent a first class metal man who can handle the executive problems, who can break in his furnace crews, and who can oversee both the molding and cleaning. Such a man is easily worth $5000 a year. He will need the assistance of a first class molder who can be elevated to the position of a subforeman at about $175 per month or $2100 a year. Under these conditions the size of the superintendent's duties will be just sufficient for him to adequately handle with the highest efficiency, and as everything will always be at his finger tips he will function with the least amount of lost motion. In many shops the superintendent walks around and looks wise. Why not put him to practical producing?

We now come to the crucial test. How much will the finished castings cost from the two units? In calculating the fixed charges we will assume conservative figures. Using acid operation the 3-ton unit will pour from 3 to 4 heats in 8 hours and from 7 to 8 in 16 hours. The small unit will pour 5 to 6 heats in 8 hours, and from 11 to 13 in 16 hours. Assuming the large heats to be 4 tons each, and the small ones 1 ton, we obtain the following figures:

	1-ton unit	3-ton unit
8 hour operation	5 tons	12 tons
16 hour operation	11 tons	28 tons

Taking the conservative figure of 8-

hour operation the yearly output for the small furnace will approximate 1500 tons, while that for the 3-ton unit will be 3600 tons.

Assuming that the total cost for the 1-ton shop is $50,000, and for the 3-ton plant $150,000, we obtain figures on fixed charges of $7000, and $21,000, respectively. These figures cover all points of depreciation, amortization, repairs, etc., figured on the same basis for both installations. Superintendence, as already shown, will amount to $7100 for the small unit, and $14,000 for the larger one.

Power Costs Compared

The comparative costs of metal in the ladle can be divided into power and labor.

The following figures for power cost were taken from actual operating sheets:

	Small furnace kilowatt per ton	Large furnace kilowatt per ton
First heat of day	750	700
Second heat of day	700	600
Third heat of day	600	530
Fourth heat of day	550	...
Fifth heat of day	550	...
Average	630	630

While the smaller furnace has the advantage of a more continuous operation, with its attendant saving in power, the larger unit has the advantage of a higher thermal efficiency, and thus the average power consumption favors the 3-ton furnace. However, another point must be considered here, that of the demand charge. The demand will be 500 kilowatts for the small furnace, and 1500 for the large size. The power companies usually make a fixed charge of so much per kilowatt measured over a definite period of highest demand. The costs are shown in the following table.

	1 Ton	3 Ton
Average kilowatt per ton	630	610
Monthly consumption	78,750	183,000
@ 1c per kilowatt	$787.50	$1,830.00
Maximum demand	500	1,500
@ $1 per kilowatt	$500.00	$1,500.00
Total power cost	$1,287.50	$3,330.00
Power cost per ton	$10.30	$10.10

On the small furnace two men will be ample to take care of all melting, charging, and ladles. On the larger unit, where greater amounts of metal are needed, more labor will be required. This is shown in the following table.

1 melter @ 75c	$6.00	$6.00
1 helper @ 50c	4.00	4.00
1 ladleman @ 50c	....	4.00
2 chargers @ 30c	....	4.80
1 scrap craneman @ 60c	....	4.80
Total	$10.00	$23.60
Per ton	$2.00	$1.97

Other items of cost include refractories, patching materials, electrodes, alloys, ore, tools, water, etc. While the cost per unit to line the larger furnace will be smaller the efficiency will not be so great and it is reasonable to assume that the items mentioned will average the same for both installations. Therefore the following comparison of charges can be made.

Small unit		
Yearly tonnage	1,500	Per ton
Fixed charges	$7,000	$4.67
Superintendence	7,100	4.73
Power	.....	10.30
Furnace labor	.....	2.00
Total		$21.70
Large unit		
Yearly tonnage	3,600	Per ton
Fixed charges	$21,000	$5.83
Superintendence	$14,000	3.89
Power	.....	10.10
Furnace labor	.....	1.97
Total		$21.79

Correcting Flaws in Metal Mixtures

Problems of the Gray Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Iron Slow in Melting

Question—We are having trouble in melting iron for range castings. We are using a cupola with a 42-inch shell lined to 28 inches. The heat averages 3000 pounds and it takes 20 to 25 minutes before the iron comes down and another hour before the whole heat is melted. Then we find that many of the castings have chilled spots.

Answer—A 42-inch shell lined to 28 inches is entirely satisfactory and should melt 1½ to 2 tons an hour. This melting rate you evidently are getting according to statement in your letter. However, you do not say how your metal is charged. The fact that metal does not come down until 20 to 25 minutes after the blast is on indicates that the bed is too high. The coke in the bed should be lowered to about 28 inches above the tuyeres and metal should come out the spout 8 to 10 minutes after the blast is on. Each charge of pig iron and scrap should weigh 750 pounds, making four charges for a 3000-pound melt. Approximately 100 pounds of coke should be placed between the different charges of pig iron, and if you add the refuse coke from the previous cupola drop on the last charge, it will tend to prevent oxidation of the last iron.

We trust this information will enable you to secure good metal. In case your trouble continues, it would be well to secure a blast gage and determine the amount of air being delivered to the cupola. It requires 30,000 cubic feet of air in melting a ton of iron. Therefore, to melt 1½ tons of metal an hour, which should be the capacity of your cupola, 45,000 cubic feet of air per hour should be delivered. Also use a pig iron with higher silicon to overcome chilled iron. The silicon in your castings should be above 2.5 per cent.

Chill Mine Car Wheels

Question—Difficulty is encountered by us in obtaining the proper depth of chill on a spoked mine-car wheel we are making. We would like to chill the entire rim and have the hub soft enough to machine readily. Please advise us the mixture to use and the composition for the wheel.

Answer—A good mixture for spoked chilled-iron, mine-car wheels could be made by using 5 to 10 per cent scrap, 30 to 50 per cent scrap iron from the mixture, and the remainder pig iron. You should have two grades of pig iron, the one with about 1 per cent silicon, and the other with about 2 per cent silicon. The other elements in both grades of pig iron should be approximately the same; that is, sulphur, below 0.05 per cent; phosphorus, not over 0.4 per cent and preferably 0.3 per cent; manganese, not less than 0.6 per cent nor more than 1 per cent. Charcoal pig iron is used in many foundries making small car wheels.

It would not be practical to cast a spoked wheel with the entire rim chilled, as that would make it too brittle. We would suggest a 5/16-inch chill for your wheel. To obtain this it would be necessary for you to make a mixture containing approximately 1.10 per cent silicon of which about 0.2 per cent would be lost in melting, and try this out lowering or raising the silicon small amounts each day until you get the required depth of chill.

You should make chilled test bars by pouring metal into molds 1 x 2 x 7

inches with a chill against one of the 1 x 2-inch ends. With this test bar you can gage the depth of your chill and control your mixture during the melt. If the chill is too deep, the addition of 4 to 6 pounds of pea-size ferromanganese to 100 pounds of iron in the ladle will decrease the chill.

Sand Must Vent Freely

Question—We are making a gray-iron casting which has a flat bottom and a thin section. A large number of small holes usually are found in the under surface of the casting, and we would like to know what causes these holes.

Answer—From the limited information we have available we would judge that the holes are caused by gasses which are unable to escape through the sand. Either you have a sand which does not vent freely under normal conditions, or the sand was rammed too hard, or it was too wet. Any one or all three combined may have been the cause of your trouble. If the sand is too wet, an excessive amount of gas will be evolved which cannot get away through the sand. Hard ramming will cause the sand to be less free venting and if the sand is not normally free venting the gases and steam formed as the iron strikes the mold will not be able to escape and pressure will cause cavities in the cast.

Black Paint for Castings

Question—Where can we procure chaplets which will leave holes in castings when put in the mold. Also we would like to know what is the best kind of black paint for castings.

Answer—You can secure chaplets for forming holes in castings from the supply houses or chaplet manufacturers which advertise in THE FOUNDRY. The kind of paint to use on castings depends somewhat upon the use to which they are to be put, but usually a black air-drying enamel is the most staisfactory. Frequently black asphalt paint is used. The castings should be thoroughly cleaned by sandblasting or pickling before the paint is applied.

First Iron Comes Cold

Question—We are having trouble getting hot iron at the first of the heat. The first 200 pounds is too cold to use and must be pigged, but the iron gets hotter as the heat progresses. The cupola which is lined to 28 inches in diameter has four 12 x 9 tuyeres 12 inches above the sand bed. We have tried different heights for the coke bed and have concluded that the best results are obtained when the bed is 34 inches above the tuyeres. The coke contains 0.10 per cent ash and 0.03 per cent sulphur. The composition of our iron for individual piston rings is, silicon 2.50 per cent; sulphur 0.90 per cent; phosphorus 0.70 per cent; manganese 0.50 per cent. As the sulphur increases we increase the amount of silicon and manganese; thus with 0.135 per cent sulphur we use 2.90 per cent silicon and 0.70 per cent manganese.

Answer—The analysis of coke which you give, namely 0.10 per cent ash and 0.03 per cent sulphur, is unusual. In fact, the amount of ash is so low that we judge the decimal point is in the wrong place, and if you are securing a coke with 0.03 per cent sulphur you are extremely fortunate. If the ash is as low as 0.10 per cent we would judge the coke was too soft for good cupola operation.

The only steps which can be taken to secure hot iron at the first of the charge are to have a good strong coke with the bed at the right height; to have the cupola thoroughly heated before the blast is on; and to have the proper amount of air. The correct height for the bed of the cupola can be ascertained by measuring the length of time from when the blast is put on until iron starts to run from the tap hole. If this time is less than 8 minutes it indicates the bed is too low, and if more than 10 minutes, that the bed is too high. Either condition will produce cold iron.

We would recommend that you light the cupola and after you get a good flame with wood, put on half the coke you intend to use. Then wait until a strong blue flame comes above the coke and add the remainder of your coke bed. Again wait for a strong blue flame before charging. The blast should not be put on until two hours after the fire has been started. The blast pressure should be maintained between 10 and 12 ounces.

You should not attempt to use the first 200 pounds of iron in individual piston-ring castings, but it should be applied to heating the hand ladles, then poured into pigs to be recharged in the cupola the next day. The first iron must necessarily be a little cooler than that which comes later because the iron receives surplus heat above that required to melt it from the incandescent coke bed through which it flows. Naturally the coke bed does not reach the highest temperature nor is the bottom of the cupola heated until after the first iron is melted, and so the first iron does not reach as high a temperature as that which is melted later. This is the reason why the first 200 or 300 pounds of iron should not be used for individual piston rings.

Should Mix by Analysis

Question—We are having trouble getting a deep chill in car wheels. We have scrap car wheels, a general run of steel scrap and a good grade of pig iron, and melt 600 pounds to a charge. Will you kindly give us the proportions of these materials we should use to get a deep chill?

Answer—It is practically impossible to lay down a definite charge without knowing the composition of the pig iron. Most gray-iron foundries use from 5 to 10 per cent steel scrap with 20 to 40 per cent of pig iron and the remainder is scrap car wheels. If you do not get a deep enough chill, you should secure pig iron with a lower percentage of silicon. In most car wheel foundries, analyses are made of the pig iron used and also of the resulting product. By this method the silicon which largely controls the chill is kept at the correct percentage. This will be from 0.4 to 0.7 per cent, depending upon the size of the wheel and the depth of the chill dsired.

Flat Core Binders

Question—Can you refer us to any special articles or give us any information as to the most economical core binder to use?

Answer—So many variables controlling the kind of core compound or binder to be used enter into each case that little has been written specifically upon the subject. All the different compounds and binders on the market have their place, depending upon the grade of sand used and the size of the core. We believe the only thing for you to do is to try out the different compounds in your work and use the one which gives you the best satisfaction from your own experience.

Of course, in a general way, it can be said that oil binders are preferable for light cores, while for the heavier cores the dry compounds and pitch binders are the cheapest.

Two Pickling Solutions

Question—We would like to have a formula for pickling for iron castings to take the scale off. We want to use this on iron castings that we use for patterns.

Answer—A good pickling solution can be made using a mixture of one part hydrofluoric acid to 10 parts water, or by mixing one part hydrochloric acid with five parts water. The one dissolves the sand and the other the iron.

Composition of Molding Sand

Typical Analyses of Molding Sands from Many Sources Are Presented and Conclusions Are Drawn to Show the Effect of Bonding Elements on Life and Refractoriness

BY HENRY B. HANLEY

EVERY natural molding sand possesses some amount of bond derived from the presence and combination of certain substances whose common property is plasticity. Clay usually is understood to give more or less bond in proportion to the amount present, but the presence of clay in a molding sand means little in regard to the strength. It is the physical condition of the clay substance present that affects the bonding or cohesiveness of the sand.

The study of clays has received a great deal of attention in recent years especially in regard to their colloid content. Most of the information obtained has been helpful in molding sand investigations, as it can be applied directly to a study of the relative bond of different sands. In the light of modern research the colloidal matter present in a sand is noncrystalline, hydrated, gelatinous, aluminum silicates, hydrated silicic acid, hydrated ferric oxide, other hydrated mineral constituents and organic colloids. These substances may be called for short the *clay substance* of the molding sand. They affect its life and plasticity; also its absorption ability for water and gases.

Colloids possessing a pronounced hydrated gelatinous nature are most desirable in a sand. On account of their minute state of division and enormous surface area they are found distributed over all the mineral fragments and cause the cohesion of the particles. Some information concerning the relative fatness and leanness of clays has been obtained by indirect measurement and through the absorption ability of clay for complicated color substances.

Many states have molding sands with bond of an entirely different chemical composition from that of sands found in other states and this chemical difference can be accounted for, according to the geologists, from a study of the formation and decomposition processes that the deposit has undergone. It is of great interest from the scientific standpoint to note the details of composition of the bonding substance of molding sands. When the results of tests of certain deposits are compared with those of other deposits, knowledge can be gained which explains in some measure the peculiar differences in the practical working of the sands.

The properties of the bonding substance are dependent, first, on the physical condition of the matter that makes up the co-called *clay substances* and, second, on the chemistry of same. The physical qualities which so seriously affect the bonding or cohesiveness are attributed to the presence of colloids in the bond. Strong bond molding sands generally have high colloid content and weak bond molding sands low colloid content. No sands in the United States which so far have been tested, show as high colloid content as the French molding sand or the English Thames river sand.

The chemical composition of the bonding substance is similar to that of many impure clays carrying high iron content, sometimes referred to as *ferruginous bond*, as well as many other impurities, alkaline earths, calcium, magnesium, sodium and potassium. Increasing amounts of the easily fusible constituents seriously affect the refractory qualities and the early incipient fusion has been observed first in the bond.

Until recently no direct determinations of the bonding or cohesiveness property of molding sands had been perfected but various methods were in use which indirectly indicated the relative amount of bond in the sand, and these methods were fairly satisfactory.

The composition of the bonding substance in synthetic sands easily can be found by direct reference to the chemical analyses of the various clays used in the mixture.

The bond of natural molding sands shows a wide variety of chemical compositions and it can be seen from a study of the analyses that at least one point can be cleared up which heretofore has been somewhat misunderstood by foundrymen. A glance at the tables of analyses of bond from different territories will show that in some cases iron oxide is found in a larger percentage than aluminum oxide in the clay substance. The iron oxide usually exists as a hydrated oxide of iron; the aluminum oxide also exists in hydrated form as hydrated aluminum silicate. In other words, the bond of such sands is not hydrated aluminum silicate (clay) alone but is a mixture of hydrated iron oxide and hydrated aluminum silicate. In such a combination we obtain the properties of both substances, which serve the purpose of bonding the sand grains. One sand with aluminum silicate predominating will act differently from another where hydrated iron oxide predominates.

Hydrated aluminum silicate appears to have better heat resisting qualities than hydrated iron oxide; the latter always will show better heat resisting qualities than any bonding substance of an organic composition, such as humus, vegetable bond, etc. Occasionally a sand is discovered close to a foundry which ordinarily obtains its sand supply from a deposit 500 miles away. The sand feels fair in bond, has good grain and is tried out as a molding sand, but the bond burns out with one casting, proving the use of this sand not economical. Vegetable or organic bond imparts cohesiveness to the sand when it is tempered with water and the destruction of

Additional Light

PHYSICAL and chemical testing of molding sands with a view to adopting standards that can be applied commercially, is a subject that has received a considerable amount of attention among foundrymen in recent years. Due principally to the efforts of a few individual investigators many facts have been brought out that previously were not known or understood. The composition of the bonding substance is related directly to the life of the sand and consequently is reflected in the number of castings produced in comparison to the weight of new sand consumed. In the accompanying paper the author presents the results of various tests conducted with sand from ten different states, with French sand and with English Thames river sand.

From the annual exchange paper of the American Foundrymen's association presented before the international foundry congress held in Paris, Sept. 12-16, 1923. The author is a consulting metallurgical chemist with offices in Rochester, N. Y.

TABLE I

Chemical Analyses of Molding Sands

	Albany District New York per cent	New Jersey per cent	Ohio per cent	Illinois per cent	Wisconsin per cent	Pennsylvania per cent
Loss on ignition	9.48	13.35	14.50	10.84	16.00	13.52
Silica (SiO_2)	41.32	52.66	44.27	48.42	51.29	43.90
Iron oxide (Fe_2O_3)	10.11	19.17	13.41	14.23	14.21	16.27
Aluminum oxide (Al_2O_3)	30.65	11.40	19.66	20.67	10.67	20.22
Calcium oxide (CaO)	3.60	1.66	3.37	0.67	2.33	3.78
Magnesium oxide (MgO)	1.53	1.01	2.02	0.48	0.98	1.40
Sodium oxide (Na_2O)	1.11	0.13	0.97	1.19	1.19	0.08
Potassium oxide (K_2O)	2.27	0.44	1.20	2.39	3.22	0.79

this bond at low temperatures occurs when the metal is poured.

An interesting example of the result of heat treatment of molding sand containing bond of organic origin, is shown in the following:

Temperature employed for test, 250 degrees Cent.; time, 1 hour; feel of sand before heat treatment, good; feel of sand after heat treatment, bad; transverse strength before heat treatment, 110 ounces per square inch; transverse strength after heat treatment, 14 ounces per square inch.

It will be noted from the foregoing that the composition of the bonding substance in molding sands plays an important part in the successful use of the sand. It is directly related to the life of the sand and consequently to the number of castings produced per ton of new sand consumed.

Hydration and dehydration of bonding substance is of great importance. Clay dehydrates gradually with rising temperature. Hydrated iron oxide dehydrates quicker than clay and at much lower temperatures. Organic bond will be destroyed at low temperatures and show no properties of hydrating again in contact with water.

When a sand is used for a time in the foundry it loses some of its bond; this is attributed in part to the dehydration of colloidal matter in the bonding substance. Van Bemmelen studied the constituents of the clay substance in the colloid condition. He states that the hydration and dehydration may be repeated indefinitely up to a certain point. Unless we begin to destroy the structure of the colloidal gels we do not harm it.

The question of the bonding substance again taking up water after partial dehydration has been quite thoroughly investigated and this point is taken advantage of in a practical way by tempering molding sands and storing them for a brief period of time previous to using.

The ideal molding sand would have a bonding substance clayey in nature, highly colloidal, difficult to dehydrate and, therefore, capable of repeated use with consequent maximum longevity. The analyses quoted indicate the absence of such an ideal bonding substance in natural molding sands and, therefore, we find quite different working properties with sands from the localities mentioned.

Chemical and Physical Properties

The chemical properties of the bonding substance of molding sands are of the utmost importance, since they have a direct bearing on the refractory qualities of the sand. Even though the base of the sand runs as high as 90 per cent silica content, this can be seriously affected by the presence of a large amount of fluxes associated with the clay substance. In a study of the refractory qualities of sands it was noted that the incipient fusion of the material was first in evidence in the finest particles of the mixture and even at a low temperature the fusion would slowly spread until it enveloped the more resistant silica and thereby bonded the mass together.

From the sands examined it seems that the major portion of the fluxing impurities which tend to lower the melting point of the bonding substance is in most cases confined in the bond. In other words, if the grain is examined separately from the bonding substance, only small quantities of fluxing impurities will be noticed in the majority of sands. On the other hand, the clay substance separated from the sand will show considerable quantities of fluxes, as is obvious in the table quoted, which easily account for the different refractory qualities observed in the working properties of many sands. Should a molding sand carry a large percentage of bonding substance high in fluxes, it would be difficult to anticipate successful results from its use, since at the moment of casting a heavy section of iron the fluxing material would melt and cement the grains, consequently closing up the pores of the sand and making it impermeable. Several molding sands with bond of this character have been investigated and thoroughly tried out in practical foundry work and it was noted that clean castings could only be obtained

TABLE III

Melting Point Determinations on Grain and Bonding Substance of Various Sands

Bond separated from grain by deflocculation and decantation, with subsequent evaporation and drying.

Molding sand from	Melting point of grain	Melting point of bond	Used for
New Jersey	1,630 degrees Cent.	1,355 degrees Cent.	Heavy and medium iron castings
New York	1,595 degrees Cent.	1,240 degrees Cent.	Heavy and medium iron castings
Pennsylvania	1,400 degrees Cent.	1,210 degrees Cent.	Heavy iron castings
Ohio	1,540 degrees Cent.	1,185 degrees Cent.	Nonferrous
Illinois	1,570 degrees Cent.	1,390 degrees Cent.	Light and medium iron castings

TABLE II

Plastic Clays Used in Bonding Steel Sands

	No. 1 per cent	No. 2 per cent	No. 3 per cent	No. 4 per cent
Loss on ignition	14.06	11.37	14.20	13.55
Silica (SiO_2)	56.11	50.27	47.09	50.78
Iron oxide (Fe_2O_3)	2.69	1.84	1.13	4.67
Aluminum oxide (Al_2O_3)	26.27	32.79	36.40	26.65
Calcium oxide (CaO)	0.09	1.86	0.32	1.09
Magnesium oxide (MgO)	Trace	0.74	0.09	1.22
Sodium oxide (Na_2O)	0.18	0.39	Trace	0.44
Potassium oxide (K_2O)	0.76	0.64	0.48	1.10

No. 1. A fairly plastic, smooth, fine grained clay from New Jersey.

No. 2. A Pennsylvania clay with good plasticity but sandy and showing fusion at 2850 degrees Fahr.

No. 3. An extensively used Missouri clay of unusually high plasticity and good refractoriness.

No. 4 A ball clay from Tennessee, with high plasticity but low refractoriness.

when the surface of the mold was thoroughly protected by a heat insulating material like silver lead. Without the use of this material the sand grains would stick badly to the surface of the castings and require a considerable amount of cleaning, which was entirely prohibitive in cost.

Molding sands having bonding substance with low refractory qualities are not to be desired from an economical standpoint and it is a fact that in this country steel foundrymen are forced to prepare their own sands, because in this way they can maintain standard conditions with their ingredients; namely, silica sand and refractory clay. When these ingredients are properly balanced and correct proportions of same employed, clean castings are produced.

Lean and Fat Clays

The physical properties of the bonding substance are similar to the physical properties of many impure clays, showing the characteristics of lean and fat clays in proportion to the relative amount of colloids contained. It matters not whether the bond carries a large amount of hydrated aluminum silicate or hydrated iron oxide. If the constituents exist in colloidal condition good plasticity will be found; should they run low in colloid content the bond will appear lean. Other properties like high and low shrinkage are observed to be similar and the color of the clay substance will vary in proportion to the amount of ferruginous bond.

To determine the fatness or leanness of the clay substance use is made of the dye adsorption test, which is a measure of the colloid content of the bonding substance. The measurement is only relative and it is in no way directly related to the bond. In earlier literature this test often was misunderstood and frequently was referred to as a bond test. High colloid content usually goes hand in hand with strong bonded molding sands, but a direct determination of the bonding or cohesiveness of a sand is one test and a measure of the colloid content is another. When high adsorption figures are obtained in the dye adsorption test they indicate that the unit of clay substance present in the bonding substance is more fully developed toward colloidal condition than in the case where a low dye adsorption figure is recorded. The lower figure indicates clay substance of lean characteristics and the higher figure obviously stands for clay substance of fat or plastic properties.

TABLE IV

Dye Adsorption Figures for Bonding Substances

Molding sand from	Grade	Adsorption per 100 grams clay substance
New York	very fine	2,480 milligrams crystal violet
New York	medium	2,160 milligrams crystal violet
New York	coarse	1,890 milligrams crystal violet
Ohio	coarse	4,000 milligrams crystal violet
Ohio	fine	3,760 milligrams crystal violet
Pennsylvania	fine	2,285 milligrams crystal violet
New Jersey	coarse	3,050 milligrams crystal violet
New Jersey	medium	8,120 milligrams crystal violet
Wisconsin	fine	3,330 milligrams crystal violet
Wisconsin	coarse	2,940 milligrams crystal violet
Illinois	medium	4,010 milligrams crystal violet
Illinois	fine	3,770 milligrams crystal violet
Michigan	medium	2,970 milligrams crystal violet
Michigan	fine	3,840 milligrams crystal violet
Massachusetts	fine	840 milligrams crystal violet
Connecticut	medium	800 milligrams crystal violet
English Thames river	fine	10,670 milligrams crystal violet
French sand	fine	14,900 milligrams crystal violet

Absorption Figures

The physical properties of the bonding substances in miscellaneous sands covering a wide territory in the United States is shown in Fig. IV.

The physical properties of the bonding substance, water absorption, amount of colloids, plasticity, longevity, impurities, etc., are related closely to the successful working of a molding sand. Many well known sands show a great superiority in longevity over other sands which might be expected from brief examination to be their equal. A definite judgment of the working qualities of a molding sand therefore calls for careful consideration and study of the constituents contained in the bonding substance.

In determining the bonding properties of molding sand use will be made now of the tentative standard test for bonding or cohesiveness recommended by the joint committee on molding sand research of the American Foundrymen's association and National Research council. This test originally was developed by R. J. Doty vice president and works manager of the Sivyer Steel Castings Co., Milwaukee, and presented to the American Foundrymen's association convention in 1922. During the past year the test has been investigated thoroughly by the subcommittee on standard tests of the joint molding sand research, as well as other workers, and has proven satisfactory and reliable in its application to a wide variety of sands. A description of the details of the bonding or cohesiveness test was published in THE FOUNDRY, July 1, on page 545.

Discusses British Iron Specifications

To the Editor: In your July 1 issue there is an editorial on the new British tentative specifications for cast iron. A perusal of the letter which accompanied the copy of the specification you received would have given the answer to some of the points you raise.

It would be well to remember that tests on the 1-inch square bar have been in use here for over 100 years. (I have before me results obtained in 1823 by Sir W. Fairbairn of over 250 tests made on 51 different British pig irons), and that considerable data has been collected with the present size bars. When the committee of the Institution of British Foundrymen decided to put forward not only three sizes of bars, but to make them circular in section, instead of the present square or oblong section, it was felt that the minimum loads fixed should bear some relation to the loads specified on the 1-inch square, or 2x1-inch section bars now in use. This has been done and the inspecting engineer knows, without calculation, that 1950 pounds and 1715 pounds on the new 1.2-inch diameter bar is equivalent to 34 cwts (3808 pounds) and 30 cwts (3360 pounds) on the old 2x1x36-inch bar, or 25½ cwts (2856 pounds) and 22¼ cwts (2700 pounds) on the old 1-inch square at 12-inch centers. Just as you, on a visit here convert our shillings and pence into dollars and cents to grasp the value of anything you wish to buy, so is a mental conversion readily possible.

It is clearly stated in the circular letter "A forward movement to improve the quality may come later."

Now to deal with the specific points you raise. I have given the reason the committee had for fixing the *tentative* loads. How do these compare with the present American specifications? Re-

duced to the equivalent of their 1.25-inch diameter bar tested at 12-inch centers, the comparison for medium castings are as follows:

		Transverse pounds strength
American		2,900
British	A	3,306
British	B	2,907

		Tensile strength pounds per sq. in.
American		21,000
British	A	24,640
British	B	20,160

With these figures before you, and keeping in mind that the American Foundrymen's association issued their specification in May 1904, and after 20 years have made no advance, and are not equal to tests "That are lowered to make it possible for even the poorest foundryman to make iron to suit them," is it not about time you *toed the line* on your side.

You mention the advance made by the Malleable association. We honor them for it. But is it not a fact that much of the improvement has been due to correct annealing? This has little to do with gray iron. You also quote the 28,000 pounds called for in the recently issued specification for high test iron. This is only a tentative specification and was issued principally as a justification for the higher price charged for semisteel castings. To quote the specification, "As obtained by additions of steel to cupola mixtures and does not refer to ordinary gray cast iron.

The surprising thing about this specification is the fact that no matter what the thickness of the casting ½ inch or 3 inches, the same transverse test asked for on the 1.25-inch bar tested at 12-inch centers. Now from long experience I know of no metal so susceptible to change as a comparative low silicon semisteel, such as would be used for a casting 4 inches thick. A 1.25-inch bar would nearly always be white under these conditions. It is here that the fundamental difference occurs between the British and American specifications.

We may take it for granted from the experiments of Turner, Cook and others, that the greatest strength is obtained when the combined carbon is around about 0.8 per cent. It will also be granted that the variation in the combined carbon content of castings from the same ladle is due to mass action and cooling effects on thick and thin castings. To illustrate: A 1-inch square bar was white and contained 3 per cent combined carbon, and 0.22 per cent graphitic carbon. The runner, 2½ inches in diameter from the casting into which this metal was run, was quite gray and contained 0.9 per cent combined carbon with 2.3 per cent graphitic carbon.

With these facts to guide us, let us examine the American specification. The 1.25-inch diameter bar tested at 12-inch centers is used all through. For the medium castings ⅝ to 1⅞ inches in thickness, a breaking load of 2900 pounds is required. For castings ½ inch thick and under a drop of 400 pounds is allowed. This seems reasonable as the 1.25-inch bar would be more open if cast from an iron suitable for thin castings. But the drop down to 2500 pounds, may also be due to the use of an inferior iron. For castings over 2 inches thick the specification asks for a breaking load of 3300 pounds, or 400 pounds more than when the bar and casting are of about the same thickness. We should look for a drop here if the 2900 pounds is a fair test for castings 1½ inches thick. The British committee has selected the size of bars that bear some relation to the thickness of the casting they represent, and calls for maximum average load on each size bar. In this way some idea of the strength and structure of the metal used is obtained. It also fails to see that the use of three sizes of bars is more complicated than three different loads on one size of bar. In fact, there is less liability of error, because both foreman and inspector know that the small diameter bars go with the thin castings, but no one can say which bar of the same size goes with the thin casting if the bars are mixed through carelessness.

I must ask you to excuse this long letter, but in view of the coming meeting in Paris it is as well that any points of difference should be known and thought about before that date.

Yours truly
J. SHAW.

The editorial of July 1 was not written with a view of criticizing the British stand on the size of test bars. The question of an international test bar is being handled ably by a committee representing the leading iron foundrymen in the principal iron producing countries. The purpose of the editorial was to call attention to the low strengths required by the new British cast iron specifications in view of Mr. F. G. Cook's statement that "a tensile test going a little beyond 31,360 pounds" is quite mediocre. Should not a tensile strength higher than 20,160 pounds per square inch, or even 24,640 pounds per square inch be required when over 31,000 pounds per square inch may be obtained in Great Britain without difficulty?

Mr. Shaw writes in referring to the A. S. T. M. specification for high-test gray castings, "This is only a tentative specification and was issued principally as a justification for the higher price charged for semisteel castings. To quote the specifications, 'As obtained by addition of steel to cupola mixtures,' and does not refer to ordinary gray iron castings". Mr. Shaw evidently misunderstood the specifiations which read, "These specifications cover all classes of gray iron castings which are required to have a high strength, including those generally known as semi-steel castings".

Make Questionnaire of Corrosion Problems

The committee of the American Society for Testing Materials investigating corrosion of nonferrous metals and alloys recently sent out 200 questionnaires to those interested in this problem. The replies indicated the desire that this committee should attempt to standardize the practice of corrosion resistance testing. The preparation of a description of the practice, not amounting to a specification, also was recommended. As a part of the preparation for corrosion resistance testing, a program of co-operative tests is deemed advisable, not primarily to determine the properties of any particular metal, but to ascertain the usefulness and precision of the proposed methods. The metals used in the investigations will be copper, lead, nickel, aluminum, zinc, and an alloy containing 29 per cent zinc, 70 per cent copper, and 1 per cent tin. The solutions to be used are to be determined by the chairman of the subcommittees.

Foundry Features Are Planned for Show

The Association of Iron and Steel Electrical Engineers will hold a meeting and iron and steel exposition, Sept. 24 to 28 at the Broadway auditorium, Buffalo, N. Y. Apparatus representing an investment of over one million dollars, it is stated, will be on display. A completely electrical foundry, producing finished castings is planned as a special feature. The papers of particular interest to foundrymen to be given at the technical sessions are: The Complete Electrification of the Foundry Industry, by L. W. Egan, American Steel Foundries, Chicago, and Electric Furnace Phenomena, by E. T. Moore, Halcomb Steel Co., Syracuse, N. Y. John F. Kelly, Pittsburgh, is secretary.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

SPECIFICATIONS FOR BRASS INGOT METAL

1. These specifications cover brass ingot metal for sand castings, known commercially as red and yellow brass ingot, made wholly or partly from scrap materials. Seven typical alloys are specified and are designated grades Nos. 1 to 7, in accordance with their decreasing copper content as specified in section 3. These specifications also cover brass ingot metal which has no grade limit, designated as ungraded material such as a specific lot of ingots having a stated composition suitable for the buyers' needs.

I. Manufacture

2. The manufacturer shall use care to have each lot of ingot metal as uniform in quality as possible.

II. Chemical Properties and Tests

3. Individual ingots of any lot shall not show an extreme variation between the high and low copper percentages of more than 2.5 per cent and between the high and low percentages of the other main constituents, except zinc, of more than 1.5 per cent. The graded alloys shall conform to the following requirements as to chemical composition, within the limits specified in section 4:

Alloy, grade No.	Copper, per cent	Tin, per cent	Lead, per cent	Zinc, per cent	Impurities, maximum, per cent: Iron	Antimony	Aluminum	Sulphur	Phosphorus
1.....	87	8	2	3	0.25	0.25	none	0.05	0.05
2.....	85	5	5	5	0.35	0.25	none	0.05	0.05
3.....	83	4	6	7	0.35	0.25	none	0.05	0.05
4.....	77	3	10	10	0.40	0.35	none	0.05	0.05
5.....	76	2	6	16	0.40	0.25	none	0.05	0.05
6.....	65	1*	2	33	0.50	0.20	none†	0.05	0.02
7.....	60	1½*	3	37	1.00	0.20	none†	0.05	0.02

*Maximum.
†See Appendix.

Specifications adopted by the American Society for Testing Materials as standard for brass ingot metal, graded and ungraded, for sand castings.

(*Continued on Data Sheet No.* 494)

SPECIFICATIONS FOR BRASS INGOT METAL

(*Continued from Data Sheet No.* 493)

4. The following permissible variations in the percentages of the desired elements specified in section 3 will be allowed, but shall not apply to the maximum percentages of impurities specified:

Percentage of element specified	Permissible variations over and under the specified value, units of per cent
Not over 5 per cent	0.50
Over 5 to 15 per cent, inclusive	0.75
Over 15 per cent	1.00

5. (*a*) Ten ingots shall be selected by the inspector to represent 40,000 pounds and five ingots for less than carload lots.

(*b*) The samples for chemical analysis may be taken either by sawing, drilling or milling the ingots and shall represent the average cross-section.

(*c*) The saw, drill, cutter or other tool used shall be thoroughly cleaned. No lubricant shall be used in the operation, and the sawings or metal chips shall be carefully treated with a magnet to remove any particles of steel introduced in taking the sample.

6. The chemical analysis shall be made in accordance with the Tentative Methods of Chemical Analysis of Brass Ingots and Sand Castings (serial designations: B 45-22 T) of the American Society for Testing Materials.

III. Marking

7. The designating mark of the manufacturer, the proper lot number, and the numerical designation of the grade supplied shall be marked on each ingot for identification.

IV. Inspection and Rejection

8. (*a*) Inspection may be made at the manufacturer's works where the ingots are made, or at the point at which they are received, at the option of the purchaser.

(*Continued on Data Sheet No.* 495)

The Werner G. Smith Co.

GENERAL OFFICE AND FACTORY

2101 W. 110TH ST.

CLEVELAND

May 29th, 1923.

THE FOUNDRY,
The Penton Publishing Co.,
Cleveland, Ohio.

Gentlemen: Attention: Mr. J. D. Pease.

We owe a great debt of gratitude to your paper for giving us the chance to tell the foundry trade about the exceptional quality of Linoil. The fact that we started in THE FOUNDRY with a part page ad years ago once a month and now occupy a double page twice a month is proof of our high esteem for the efficiency of advertising in THE FOUNDRY and the standing which we know you have among the foundries of the world.

Yours very truly,

THE WERNER G. SMITH COMPANY

Werner G. Smith

President.

WGS/k.

Foundry Costs Simplified-VII

Steps Taken in Carrying Through an Order Are Outlined To Clarify the Details Given in Previous Articles — A Summary of the Cost Procedure Shows How To Determine Profit or Loss

BY ALFRED BARUCH

TO MAKE the procedure described in the previous articles clearer, and to show how simple this system is in application, a concrete example is given of the procedure followed in the case of a specific order.

It is assumed that this is a jobbing foundry. It is requested to bid on a job calling for 100 castings with cores, each casting to weigh 160 pounds. The first step is to make the estimate. Assuming that the job is accepted, the next step is to make out the production order and release it to the foundry clerk, who in turn makes out the pattern card and turns the order over to the foreman who does the job and returns the order. The following is an outline form of the steps to be taken:

Estimate—The estimate is made out by the superintendent or the owner himself. It shows the customer's name, his address, date, the number of pattern, the quantity of castings required and a description of them. So much is entered in the heading. The body of the estimate contains a detailed analysis of the operations required for this job. It states above that the job consists of 100 castings, each one weighing 160 pounds. Because of the nature of the castings it has to go through the following operations:

Coremaking.
Molding.
Sandblasting.
Cleaning.

The column to the right of the sheet shows the cost of the direct labor and the burden for each operation. The estimate shows the labor and burden for coremaking, molding, sandblasting, and cleaning, as given in Table I.

The cost of metal per pound, after all deductions and allowances is figured at 2 cents, making the metal cost $320 (2c x 16,000 pounds). This $320 is added to the $302 cost of labor and burden, which gives a total foundry cost of $622. To this is added 10 per cent for administrative and selling expenses, which makes $684. This represents the entire cost. To it is added 10 per cent for profit, making the final price for this job $720 or if the bid is made on the pound basis, there are 16,000 pounds which divided into $752 gives 4.7 cents per pound.

Production Order — The above bid having been accepted, the superintendent now proceeds to make out the production order. He writes this order out on the regular form designed for the purpose showing:

Customer's name.
Address.
Date.
Order number.
Pattern number.
Date promised.
Quantity shipped.
Description.

The body is a blank, allowing space for the operations and the cost of labor, burden and material. This order is now forwarded to the foundry clerk, one carbon copy of it having been retained in the office files for record. These files are kept on the superintendent's desk, arranged chronologically. Each day he takes up the orders that are due for shipment on that day and compares them with the weight sheet or shipping report of the night before.

Pattern Card — As soon as the foundry clerk gets the production order he makes out a separate pattern card for every pattern on the order—in this case only one. The pattern card contains the following information filled in by the foundry clerk. Pattern number, time, shelf or bin number, customer, boxes, pieces, kind of metal, work for casting, date received, date returned, special instructions. He then turns the triplicate copy of the production order over to the foreman, who as a rule looks after the patterns himself. As this casting requires cores, the coremaker is instructed to make the necessary ones.

The time the coremaker spends on this order or job is recorded either on the Distribution of Time Sheet or on an individual card showing the order number of this job, the number of cores made and the elapsed time. The pattern is given to a molder who makes necessary molds, and the time spent on this particular job is recorded in a similar manner, the preferred method being the Distribution of Time sheets which charge each job with the time spent upon it.

Expense Routine—The foreman finds that a special flask has to be prepared for this job. Therefore, he makes out an Expense Charge slip, instructing the carpenters to make the flask. As has been pointed out in a previous article, flasks are treated as indirect expense, for it is possible to use the same ones over again, and even when special flasks are made it may be possible to use them again on another job. The expense charge slip shows the account to which this particular expense is to be charged and it is filed in the office under that number.

Reconciliation of Costs — When the castings for this job have been cleaned and weighed they are entered on a weight sheet. The defective castings

TABLE I

Labor Costs from Estimate Sheet

Operations	Labor	Burden	Total
Coremaking	$10.00	$8.00	$18.00
Molding	102.00	122.00	224.00
Blasting	12.00	13.00	25.00
Cleaning	15.00	20.00	35.00
Total	$139.00	$163.00	$302.00

TABLE II

Corrected Labor Costs

Operations	Labor	Burden	Total
Coremaking	$9.00	$7.00	$16.00
Molding	100.00	120.00	220.00
Blasting	10.00	11.00	21.00
Cleaning	20.00	23.00	43.00
Total	$139.00	$161.00	$300.00

are cast again and then the order is ready for shipping. Meanwhile the foundry clerk who also does the weighing, determines the cost of the job. He collects all the time sheets which contain this order number and enters the labor charges against each department corresponding in detail to the estimate made. The total now reads as given in Table II.

The estimate was $302 and, therefore, $2 has been gained in actual operation. The metal cost is fixed, since the figure of 2c per pound previously given is based on actual record.

The foundry clerk's copy is returned to the office where the unit cost, that is, the cost per casting, is entered in the estimate book and forms the basis of future estimates for similar jobs.

Summarize Cost Procedure

The three elements of cost are material, labor and indirect expense. The authority to purchase really comes from the production orders received by the foundry. Based on these orders, the purchasing agent buys iron, coal and the other supplies. In practice, the foundryman gambles on the demands that are to be made on him for these materials and buys them in advance. The same holds for the supplies. The labor is hired as the need arises.

Thus the first step in the collection of cost records begins with the first expenditure of money. A request is made for the purchase of a given quantity of iron. When this request is filled, an account is opened in the general books for iron. This is known as a controlling account and corresponds to the details of the ledger. Because the foundry has only two or three different kinds of material to deal with, it is possible to determine the cost of metal through the information contained in the general books alone. The purchase price of the iron plus the cost of transportation and handling makes the cost of pig iron. By adding the cost of melting and deducting the allowances for scrap, the cost of metal at the spout is obtained.

The cost of direct labor is found by the use of the distribution of Time sheets made out by the foundry clerk, or by the use of any of the substitutes mentioned in the articles. These records are maintained by jobs whether the foundry works to stock or whether it does only jobbing work. In any case, the number of hours accumulated under one order number times the standard rate of pay per hour for each class of work gives the direct labor charges for each job and incidently for each class of work.

The indirect expenses are found by pretending that each group of expense represents some customer's order and all labor and supplies used for it are charged through the use of an expense order number. If sand is needed for facing, the requisition is identified by the expense order number covering facing sand in the cost ledger. The cost ledger is maintained because it is not convenient to go into the details required for cost purposes in the general books. Therefore, all indirect expense is represented in the general ledger by a single account, the details of which can be found in the cost ledger.

The totals of these expenditures are brought together at least once a month in the report which is referred to as the Monthly Comparison of Foundry Costs. This report lists the expenditures by departments and the total of them is the actual cost for the month. This is compared with the standard cost for the month to determine whether or not a profit was made on the plant operations which is the end and purpose of cost records.

Connecticut's Foundry Industry Surveyed

An investigation of labor conditions, production and wages in the foundry industry by the Manufacturer's Association of Connecticut portrays the growth of the industry in Connecticut, covering the period from 1913 to 1923 together with the intervening effects of the World war. The results of this investigation are embodied in a complete report. This is a digest of the changes which the foundry industry of Connecticut has experienced and is interesting because typical of the average conditions in New England.

The statistics show that the average consumption of metal per day by all classes of foundries increased 30.2 per cent from 1913 to 1923, while the increase from 1913 to 1920 reached the amazing figure of 62.6 per cent, due to the high pressure production characteristic of all industry at that time. The number of employes in the aluminum, brass and bronze shops changed normally, increasing 12.6 per cent by 1923, although the total reached 35 per cent. The number of employes in the gray iron shops decreased 2.17 per cent from 1913 to 1923, although the increase in 1920 was 37 per cent. The fact that the average number of working hours per week decreased 7.37 per cent from 1913 shows that the lower number of employes in the gray iron shops is attributable to some other cause than a longer work day. In the gray iron foundries the average decrease in operating hours was 8.7 per cent and by 1923 the decrease in the aluminum, brass and bronze shops amounted to 6 per cent.

An interesting feature demonstrated in the report is the increase in wages. The wages of unskilled labor in the gray iron shops were at a peak in 1920 when they had advanced 155.5 per cent over the corresponding wages of 1913. By 1923 this increase was diminished to 115.1 per cent over the 1913 level. The general average of wages of foundry workers reached its highest point in 1920 when the wages were 162.3 per cent greater than in 1913. This increase was reduced to 121.2 per cent in 1923. The wages of unskilled labor increased much more than those of skilled molders and coremakers. Where rates paid to unskilled men rose 155.5 per cent, those of skilled labor advanced only 137.4 per cent. The peak in wages of molders and coremakers also was established in 1920, but at best the increase was 18 per cent lower for the trained men than for the common workmen.

At the present time the average number of apprentices in all Connecticut foundries amounts to 2.7 per cent of the total number employed, which would constitute a sufficient supply of skilled men to replace those incapacitated by death and injuries, but insufficient probably for a time of greater production.

Opens New Foundry

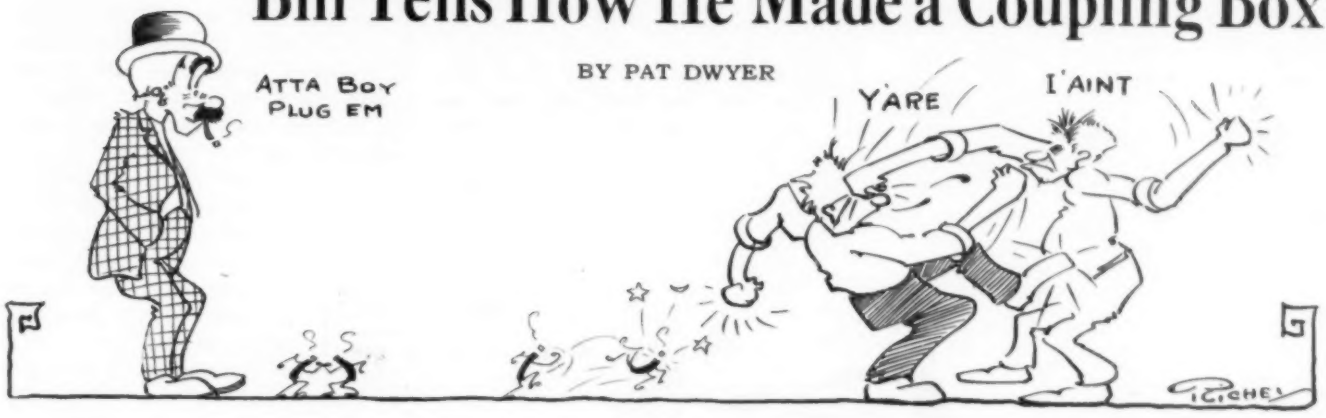
The Vulcan Mold & Iron Co., Latrobe, Pa., has built a new iron mold foundry and has purchased the entire mold business of the Blairsville Iron Works, Blairsville, Pa. Operations were started in the new foundry about three months ago and the output is now up to about 50 tons a day. The plant, which occupies 5 acres of land, consists of the main foundry, 180 x 300 feet and one building 70 x 90 feet. Auxiliary buildings include machine and pattern shops.

The authorized capital stock of the company is $500,000. E. H. Williams is president. The board of directors consists of C. M. Semler; M. W. Saxman; J. E. Barnett; F. B. McFeely; H. H. Smith, and D. T. Sipe, chairman.

The Palmer Foundry & Machine Co., Palmer, Mass., manufacturing cast iron soil pipe, has recently been reorganized and plans for expansion are now under way. The foundry melt is expected to be trebled shortly.

Bill Tells How He Made a Coupling Box

BY PAT DWYER



PERSONAL experience, as you probably have observed, is a wonderful factor in helping us to change or revise our estimate of certain features, conditions, events and practises on which we formerly may have held rather positive opinions. Strong minded people, which simply is a polite and euphonious method of saying obstinate people, probably would take exception to the statement if I were to advance it orally in their presence; but since I am sitting here alone in an old easy chair with my stockinged feet cocked at a discreet angle on a second chair, I feel reasonably safe in-so-far as precipitating a controversy is concerned. I am fortified further by the reflection that these sage observations will not appear in print for several weeks and by that time I will have forgotten all about what I now am setting down with the aid of a little short stubby pencil.

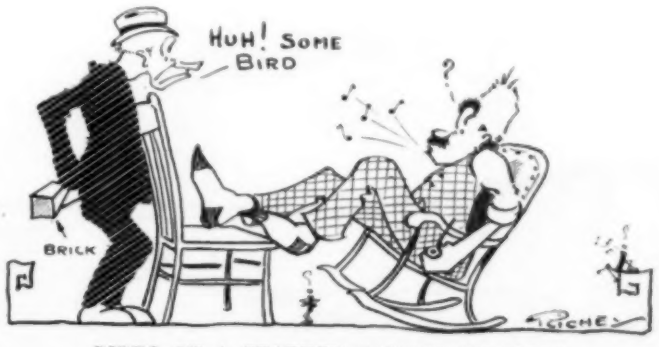
In my early days I fancied a long, delicately pointed pencil and usually carried at least three in an upper vest pocket. I discovered gradually that in the height of the school season the average life of a pencil displayed in what I might call a criminally negligent manner was 1.66 days and I finally decided that a little stump about 2 inches long really was what I needed. I am certain no person will steal it and I have demonstrated to my complete satisfaction on hundreds of occasions that no one wants to borrow it. Essentially I am a man of peace, but occasionally I enjoy a little argument. I also am willing to admit that I derive a certain amount of vulgar pleasure in listening to two otherwise respectable citizens get all heated up over a controversial point. One of these cases where they become sufficiently in earnest to throw the King's English in the discard; where they punctuate their arguments with emphatic words which the demure and delicate minded printing fraternity, that great bulwark of the home, the minds and morals of the people, disguises under the form of dashes. The fact that the aforesaid common people experience no particular trouble in mentally translating the dashes, apparently never is taken into account. Probably on the ground that this is one of the prices we must pay for our higher and almost universally compulsory education.

I like to see and hear two husky lads verbally flay the everlasting hide off each other, salt it down and hang the gory and quivering trophy on the sunny side of the old picket fence to dry. The action is quick and snappy and one has no trouble in following the various steps in the operation and noting with approval the points scored by either or both contestants.

Contrast this with the dignified, long-drawn-out and wearisome arguments occasionally inflicted upon us by a press that should know better. One gladiator writes a simple statement of fact as it appears to his, sometimes, simple understanding. A second fire eater reads the statement half way through, guesses at the remainder, jumps to the conclusion that the first man is trying to put over something and immediately rushes into print with a long statement calculated to prove: (1) That the first man has mistaken his vocation, he should be between the shafts of a costermonger's cart. (2) That the argument is based on totally erroneous premises and, therefore, the conclusions are not worth one German mark per thousand. (3) That the second man has the only really authentic, genuine inside dope on the subject. (4) That this is only a preliminary warning. If the first man is not willing to retract his statements and acknowledge his ignorance, the second party will be forced to take drastic measures in a future communication. He concludes with a few dark and mysterious hints to the effect that he is somewhat of a specialist and takes particular delight in figuratively taking those with the necessary impudence to set up an opinion in opposition to his, nailing their ears to a pole, saturating them with kerosene oil and setting fire to them.

The first man comes back and proves conclusively, to his own satisfaction, that the second is practically an illiterate. He quotes extensively from his first article, then quotes his opponent's comment and then calls on high heaven to witness that any person capable of thus distorting a simple statement must be either an imbecile or a criminal.

Naturally the second combatant is annoyed to find that his broadside, calculated to sink the enemy with all hands, stores and ammunition, apparently has been wasted. He quotes passages from the first article, repeats his reply and almost invariably trips himself in trying to shift from the first to the third person. By the time the controversy has passed the third communication the average reader has as much chance of determining the relative merits of the question at issue as he has of extracting information from an income tax form. However, all this really is beside the point I had in mind when I started to write. It is so much easier for a man to let his mind wander than it is to keep it on a specified line. I was going



BIRDS OF A FEATHER GATHER NO MOSS

to comment on the manner in which personal experience colors opinions and since that idea suggested differences of opinion and arguments I drifted imperceptibly for a short distance with the current. Let's shake it out and begin again.

Several years ago one of those unfortunate inhabitants of tin pan alley who spend their lives in fitting atrocious music to still more abominable combinations of words, touched the public fancy for a brief period with a piece of drivel purporting to voice the sense of exquisite joy and independence experienced by the man whose wife has gone to the country. Hurray! Hurray! I was not particularly interested at the time and, therefore, am not prepared to make a positive statement, but it seems to me that I never heard that song from a man whose wife really was in the country, hurray or no hurray! So far as I can remember the wives of many of these troubadours not only were not in the country that particular year, but they never had been in the country and if they were to wait until some of these precious lads suggested that they go to the country for an indefinite period of rest, they never would see a single blade of grass, a baa-baa black sheep, or a domesticated descendant of the cow that jumped over the moon.

Strong words, says you, but my wife has been away to the country for two months and the fact that she has taken the children with her, hurray! hurray! does not seem to affect me in the boisterously exuberant manner of the man the author of the song had in mind when he strung the pitiful creation together. I should say not. On the contrary I should be inclined to say offhand and without going too deeply into the subject—after the manner of our modern novelists who sandwich about four pages of dreary analysis of the hero's mental reactions, between consecutive incidents germane to the story—I should say, that I have enjoyed the past two months in about the same degree as some of my extremely remote ancestors enjoyed wearing a hair shirt and a shovel full of ashes on their heads.

She did not take all the children with her. A sufficient number remained behind to keep the home fires burning, and all that kind of thing, and incidentally furnished me with a paragraph in my daily bulletin to the effect that the house still was intact and had not been burned to the ground up to the present writing.

Everything comes to an end eventually, even a vacation, and when Bill came

ALWAYS SOME ONE TO SPOIL THE PARTY

up the steps last night he found me sitting on the veranda, whistling an old time dancing tune that in some mysterious manner had come stealing out of memory's vault and which in fancy carried me back to many a carefree time in the days when we were twenty-one. Bill seated himself silently while I executed a few extra flourishes and threw in a few grace notes for his benefit. He did not seem to be impressed. In fact he favored me with what I have been led to believe is referred to in some quarters as a hard look.

"What's the idea?" he said. "The last time I was over here you were wearing a face as long as a French fiddle and your conversation was about as cheerful as that of Hamlet's ghost or the chief mourner at a funeral. Now I find you perched on two chairs piping away as gaily as any whistler that ever cocked a lip. You sit there as snug and complacent as if you owned the earth with a little green picket fence around it and in addition as if you had a 99 year lease on the moon for a goat pasture. Without any inside knowledge of the circumstances and merely basing an opinion on the symptoms displayed I should say either that the Missus is on the way home, or you had an opportunity of sinking a harpoon—probably poisoned—neatly and scientifically behind the left shoulder blade of a favorite enemy, during the day."

I pointed out in this enlightened age it is not considered seemly to talk of sinking harpoons, poisoned or otherwise, in people even if the same people are classified as enemies. "I don't know what you think about it," said Bill; "enlightened age or no enlightened age. I am not a member of the ancient Jewish faith, but I entertain a warm and kindly feeling for that particular article in the Mosaic law that called for an eye for an eye and a tooth for a tooth. In fact I would feel like exercising another characteristic of the same well-known people and exact payment with compound interest. I should like to collect at least two eyes for every eye and at least a handful of teeth for every tooth taken from me violently. In this respect, at least I am glad to say that my mind runs in the same groove as that of a clergyman I knew at one time, a fine, upstanding 6-foot specimen of muscular Christianity. His duties carried him over a wide range of territory, including a string of lumber camps where might was right and where a peavy or a cant hook usually determined the finer points of an argument.

"He arrived at one of these camps in the afternoon and after supper invited the men to gather around for a little preliminary and informal talk. The majority of the men were inclined to view the visitor with friendly interest; but of course a few, headed by Black Dan the camp bully looked upon the man as an alien and the purpose of his visit as an unwarranted intrusion on their rights and liberties.

"At a certain point in his talk the apostle of peace stopped and invited questions from the crowd. Black Dan

BREVITY IS THE SOUL OF WIT, BUT WITTY TRAVELERS ARE FEW AND FAR BETWEEN

immediately jumped at what he considered a beautiful opportunity of killing two birds with one stone. He thought he could drive the sky pilot out of the camp and at the same time enhance his own reputation as a bad man, one who ate 'em raw and who ate 'em rare. He asked the preacher point blank if he was prepared to back up his teaching. Would he turn one cheek if struck on the other? He would. Dan lost no time in testing the truth of the statement. He walked up in front of the missionary and deliberately slapped one cheek and when the other was turned he also slapped that and then stepped back to wait for the next move. He did not have long to wait. 'My dear friend,' said our hero. 'In a somewhat diligent perusal of the Scriptures extending over a period of many years, I never have seen any reference on how a man is supposed to act after his enemy has smitten him on both cheeks. I am led to assume that a man is justified at that point in laying down a law for himself, or acting according to the dictates of his conscience. Therefore, I assure you, I anticipate the most exquisite pleasure in pounding into you the rudiments of good manners, a little common courtesy in the event that another wayfarer comes this way and enough of the basic element of all religions to start you in the way of eventually saving your immortal soul.' According to the account later relayed to civilization he not only made good on all three counts, but he also added a few vicious uppercuts by way of good measure and concluded the ceremony of conversion by a right and left hand swing to either cheek with his open palms that repaid his own experience of a short time before, with usurious interest.

"Rules and regulations are all well in their place, but conditions constantly are arising where a man is required to interpret the rules according to his best judgment. I adopted a method for making steel mill coupling boxes at one time that illustrates this point.

"This box, 24 inches in diameter was designed to be molded from a solid pattern with the inside formed by a dry sand core made in an individual corebox. The method was fairly satisfactory and in fact is employed to a considerable extent in many foundries that at present cater to steel mill requirements. Lack of adequate crane service and congested foundry conditions led me to develop a method which reduced the number of lifts required and incidentally produced a better casting. Probably, it was no better so far as wearing quality was concerned, but it presented a better appearance and reduced the amount of chipping required before it was placed in service.

"The mold was made in a 30-inch diameter flask provided with a pocket for the reception of a runner leading to the bottom. No change was made in the pattern which was provided with a single core print on the bottom, or in the corebox in which the up and down pads were held in place by long pins extending through the wall of the box. The same flask in which the mold was made as a two-part job, now served to make it as a three-part job by converting the deep center section into a cheek. Briefly the change consisted in ramming the core directly on the drag instead of making it in a distant part of the foundry and then setting it in the drag after both parts of the mold had been dried."

FAKED FOUNDRY FACTS

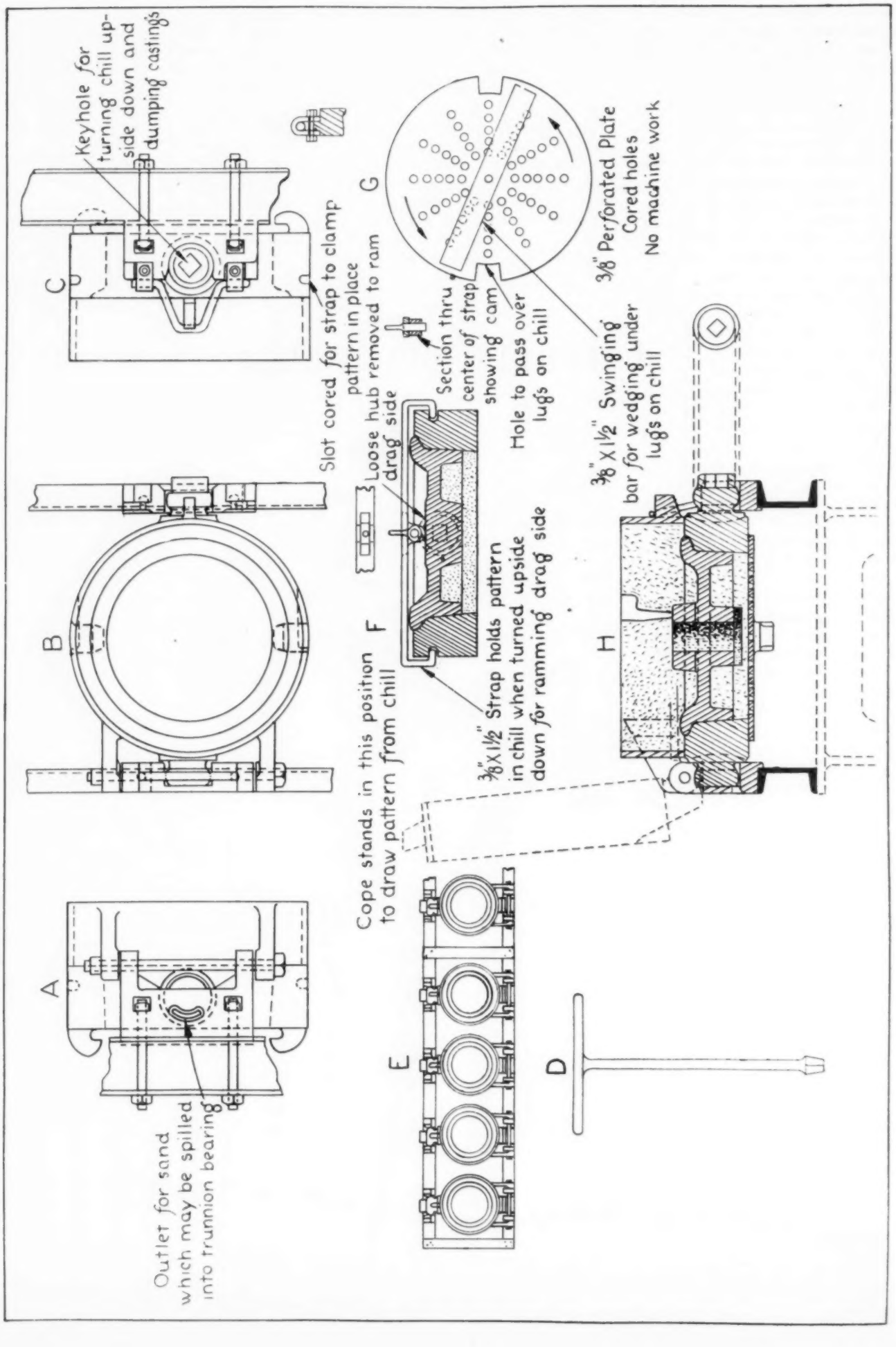
AN UPSET

Apparently he noticed that I was not paying any particular attention to what he was saying. He rose to go and then as an after thought he said: "Do you expect the Missus to turn in an expense account when she returns?"

"No," I said. "I do not. In the first place it would not add anything to the sum total of my financial knowledge if she did and in the second place I think she would hand in an account—that is if I was silly enough to ask for it—something in the same style as the famous expense sheet handed in by Sam Sleeth one time. Several years ago the general manager handed Sam $200 with instructions to take a few weeks off and make a tour of the foundry circuit with a view of observing general foundry conditions. Sam returned in about a week, quietly resumed his duties and said nothing. The manager waited a week or ten days and then suggested tactfully, that the traveller present a report covering his expenditures. Sam retired to his den, procured a large sheet of paper, moistened his pencil in approved style, sat in deep cogitation for an hour and then handed in a report which read: Received from the Westinghouse Co., $200 for expenses. It was enough."

"Well," said Bill, "perhaps you are telling the truth and perhaps you are not. I won't go so far as to say that you would deliberately misrepresent the facts in this or any other case, but in this instance you probably are quoting some third party and are not personally familiar with the circumstances or with the hero, himself in person. The main part of your story may be correct. I won't argue vociferously on that point. The only feature that leads me to doubt the authenticity of the account is the statement specifying the amount of money on which Sam was supposed to see the country and exist for several weeks. I guess you don't know Sam!"

The Portland Foundry Co., Portland, Conn., has elected the following officers: President, Charles L. Warner, Milford, Conn.; vice president, Burton J. Calkins, Stratford, Conn.; secretary and treasurer Horace C. Finkle. These also are the directors.


A
Outlet for sand which may be spilled into trunnion bearing
B
C
Keyhole for turning chill upside down and dumping castings
Slot cored for strap to clamp pattern in place
D
E
F
Loose hub removed to ram drag side
Cope stands in this position to draw pattern from chill
3/8"X1½" Strap holds pattern in chill when turned upside down for ramming drag side
G
Section thru center of strap showing cam
Hole to pass over lugs on chill
3/8" Perforated Plate Cored holes No machine work
H
3/8"X1½" Swinging bar for wedging under lugs on chill

DETAIL AND ASSEMBLY VIEW OF A PERMANENT SET OF RIGGING DESIGNED AND DEVELOPED FOR MAKING 12 INCH CHILLED WHEELS

Reduce Labor on Car Wheels

Marked Savings in Time and Labor Are Effected by an Improved Method Developed in the Shops of a Western Mining Company for Making Chilled Wheels for Mine Cars

CHILLS for standard gage railroad car wheels are so heavy they cannot be handled by hand and therefore cranes are provided for the purpose wherever car wheels are made. Small chilled wheels, particularly those used in mines, employ smaller chills which are not considered heavy enough to require a crane and yet entail an exceeding heavy burden on the molder obliged to lift them several time a day by hand. The manner in which this drudgery was eliminated in the foundry of the Homestake Mining Co., Lead, South Dakota, is shown in the accompanying illustration. The method was developed and placed in operation by Hugh A. Mackie and Charles Parsons, pattern shop and foundry foreman respectively of the company. A blue print showing detail and assembly of the rig was submitted in the Obermayer contest at the convention of the American Foundrymen's association in Cleveland and was awarded the prize as the most meritorious device coming within the limits imposed by the donor of the prize.

By referring to *E* in the illustration it will be noted that the system is elastic in that while one pair of channel beams forms a unit, the number may be extended indefinitely, depending on the size of the foundry and the relative demand for this class of castings. The channel beams supporting the chills are mounted level and parallel and thus automatically maintain the chills level at all times; one of the factors recognized as an essential in securing sound, homogeneous wheels with an even chill on the tread.

The chills are provided with trunnions and remain permanently mounted on the stands. After the casting is poured it is dumped by reversing the chill. The cope is hinged on one side to the cradle supporting the chill and may be swung back out of the way when drawing the pattern and also while the chill is rolling back and forth. This feature is illustrated in the plan and section *B* and *H* respectively where it will be noted that the cope swings from left to right while the chill rolls over in the same direction as the channel beams. Contrary to the manner in which large car wheels are made these wheels are poured in the position shown, that is with the flange up.

Open cast iron frames 15 inches high spaced 6 feet 6 inches apart support the channels at a convenient height to permit removal of the castings from underneath. The top of the completed mold is approximately 30 inches above the floor level and therefore a crane ladle may be employed to pour the metal into the runner basin.

The wheel chill is about 2 inches deeper than the tread of the wheel and the extra depth is utilized to serve as a drag. This feature is illustrated at *E* and *H*.

In practice the pattern is placed in the chill while the latter is in the position shown at *F*. The double toe clamp is placed across the center with the toes in slots in the side of the chill provided for that purpose. A lever and cam in the center of the clamp is employed to bring pressure to bear on the center of the pattern and then the pattern and chill are rolled over. In this position sand is rammed over the pattern in the space inside the chill wall corresponding to the drag in the usual assembly. The sand is scraped off flush with the edge of the chill after which the cast iron bottom plate *G* is adjusted in place. The plate is provided with a swinging bar across the center and two gaps at diametrically opposite points. The gaps provide clearance for two lugs on corresponding points on the chill. These lugs which are shown in *B* and *H* are slightly tapered and therefore when the bar is driven under, it is automatically tightened without any wedges.

The cope shown in two positions, in section and outline respectively in *H* is hinged to the cradle supporting the chill trunnion on one side. Detail of the hinge, bearing and bolts is shown at *A*. This bearing is provided with an opening for the removal of any sand that may fall into it incident to rolling the cope up and down.

The view at *C* shows the opposite side of the assembled mold with particular attention to the detail of the clamping device for holding cope and chill together during the pouring operation. The clamp is in the form of a link held in place by two toes that pass under straps bolted to lugs on the trunnion cradle. After the mold is closed the link is swung up to a vertical position and engages a lug on the cope. This lug is tapered slightly and therefore as the link is forced on, it automatically tightens itself. The hinge by which the cope is attached furnishes all the guide required to close the cope in its proper relative position on the chill each time it is used.

The cope hub on the wheel pattern is independent of the remainder of the pattern and is located in place by suitable dowel pins. This feature is optional and simply is a reflection of the personal taste of the designer. Many patternmakers and foundrymen prefer hubs of this character fastened firmly in place. They base their opinion on the claim that pins occasionally wear loose and result in distorted castings; also that it is easier to keep track of a pattern all in one piece than it is where a pattern is made up of two or more pieces. Supporters of the loose hub construction method claim that with reasonable care the dowels and pins will remain accurate as long as the remainder of the pattern. The prospect of the hubs getting lost is regarded as a remote contingency. The advantage of a loose hub lies in the fact that it is an important factor in aiding the molder to secure a clean *lift*. The hub comes with the sand when the cope is lifted.

Attention is directed to the special type of center core. It is provided with a flange at one end which completely fills the lower part of the hub in the mold. This foundation does away with the need of a cope core print and also furnishes a firm surface to receive the first fall of the iron from the pop gate on top.

Metal Pattern Plates Are Desirable

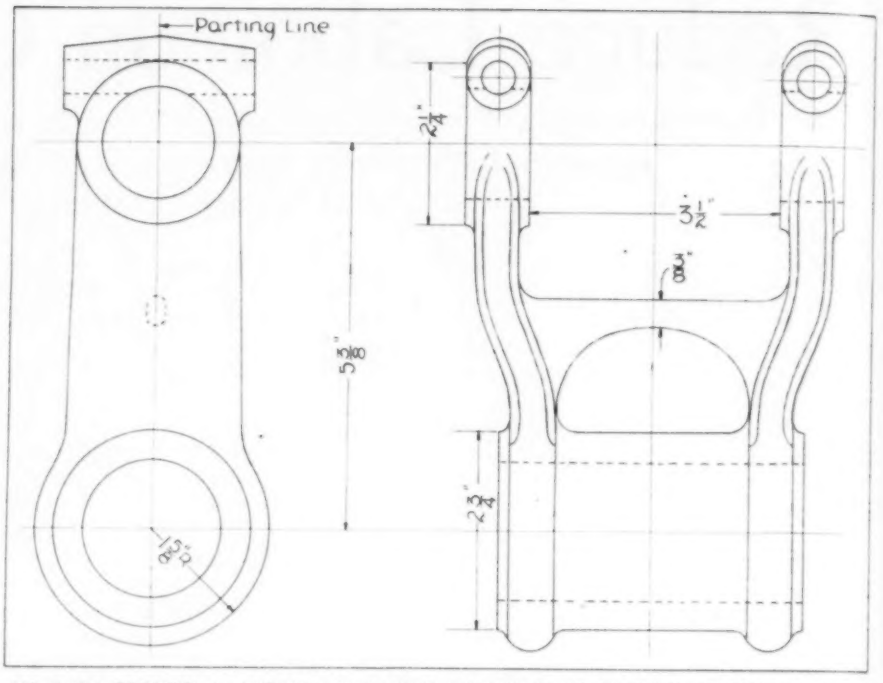
By C. J. Monett

In mounting split patterns on squeeze machines for production purposes it sometimes happens that through motives of economy the pattern shop will mount the patterns on wood boards instead of on the proper metal pattern plates. Careful attention to the proper mounting of patterns will prove economical both in the pattern shop and in the foundry.

The accompanying illustration shows a spring shackle pattern which was mounted on a 1¼-inch board; half of the pattern being in the cope and and the other half in the drag. When the pattern was put in the sand a shift of 1/16 inch developed in casting. The pattern was checked for errors, but none were found as the patterns matched perfectly on the board. Another mold was made to locate the trouble. The mold was checked after removing the pattern by placing small square pieces of paper on the face of the drag, half of the squares to correspond with the edges

of the mold. A small amount of paste was put on each piece of paper. The cope was then carefully let down in place. The trouble was at once apparent as the shifting of the pieces of paper proved conclusively that the flask pins were out of perpendicular approximately ⅛ inch to the foot. When the pins were corrected the job was run without any further difficulty.

Had this pattern been mounted on a metal pattern plate not more ¼-inch thick the small variation would not have had any noticeable effect on the casting, and the resultant time and money would have been saved. The point to bear in mind is that the less distance between the two parts of the pattern the less likelihood there is that any variation in the two parts of the pattern will appear in the mold. It is this feature that gives metal is marked advantage over wood.



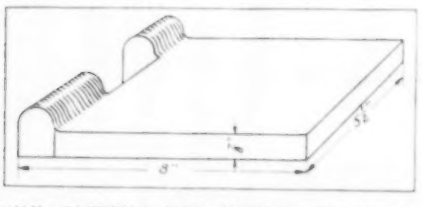
IN THIS FIGURE A SPRING SHACKLE PATTERN IS SHOWN MOUNTED TO A 1¼-INCH BOARD

Simple Casting Requires Simple Pattern

By M. E. Duggan

The casting shown in the accompanying illustration is so simple in design that when it broke, a new one might have been made at practically no cost for pattern making. The broken casting would have made a satisfactory pattern. A piece of lumber could have been cut to the desired shape in a few minutes on the band saw. A piece of slab core could have been filed to serve as a pattern. In fact if the accident happened in the foundry or in the presence of a foundryman the mold for a new casting could have been prepared in less than half an hour.

In this particular instance the accident happened in a machine shop where the superintendent apparently was not familiar with either pattern making or foundry practice. He made a sketch of the casting with a view of having a pattern made in a local pattern shop. He entrusted the sketch to his latest apprentice and told him to hurry so that if possible the pattern and casting might be made the same day. You may imagine his surprise and gratification when the boy told him that he formerly had worked in a plaster casting shop and knew all the tricks of the trade. He claimed if he was supplied with a few pounds of molders clay and a bucketful of plaster of paris he would produce a pattern in about two hours.



THE CASTING FOR WHICH AN ELABORATE PLASTER PATTERN WAS CAST

The idea looked so good to the superintendent that he sent the boy down town for clay and plaster and then stayed in the vicinity, beaming, while the boy made the plaster pattern. First he made a clay model the shape and size of the casting. This was placed on a board, surrounded by a frame and the frame filled with liquid plaster. After the plaster had set the clay was removed and the space formerly occupied by the clay was filled with plaster. When this second quantity of plaster had solidified it was removed from the plaster mold and was sent to the foundry to serve as a pattern.

Plaster of paris has its place in the pattern shop as well as elsewhere but I do not think its use in this instance justified the superintendent in publicly boasting that between himself and a smart young apprentice he had developed a money saving method.

If the boy had spent a few months in a foundry, he would have had more sense than to propose such a method of making a hurry-up pattern and incidentally he would have been better qualified in every way to learn the trade of a machinist.

Sand Does Not Lift

Question: We use an aluminum pattern for making our brake shoes. The brake rod lug is on the drag side and the groove which engages the flange of the wheel is on the cope side. We are not able to get a clean lift on the cope, the sand forming the groove cracks and breaks away. We will appreciate an expression of opinion on the probable cause of the trouble.

Answer: If you are using sand with a fairly good bond we see no reason why your cope should not lift properly. It may be that the outside wall of the groove is vertical instead of being drafted at least ⅛-inch and in addition it is possible that the flask pins may be a little loose. It readily is apparent that any lateral movement of the cope while lifting will crush the narrow strip of sand against the pattern and loosen it. After sifting a little sand over the joint, stand a few nails in the groove, then ram the cope fairly hard and lift one side before the other. If the pattern is mounted longitudinally, lift one end of the cope before the other. However, the proper remedy is to use a good grade of sand and to provide flasks with tight fitting pins. These castings frequently are made the other side up and the lug for the brake rod is formed in a block core rammed on top of the pattern.

The Great Western Smelting & Refining Co., Chicago, is constructing a new warehouse and smelting plant on Russell street, Detroit. J. B. Newman is manager and Albert Kahn, Detroit, is architect.

The foundry of the Ware Foundry Co., Ware, Mass., which was destroyed by fire June 7, has been rebuilt and enlarged. Operations were resumed Aug. 15.

How and Why in Brass Founding

By Charles Vickers

Aluminum Plates Cast in Permanent Molds

We desire all the information possible about casting aluminum kick plates for automobiles in permanent molds. We would like to learn what material can be used to make such castings successfully, in place of the ordinary sand. We are advised plaster of Paris molds will turn out several castings before they become too pitted for further use, but such molds are not permanent.

An impression seems to be gaining ground that there is some mysterious method of casting aluminum in molds that never wear out. It naturally follows that many are greatly interested because on the face of it such a method would be a bonanza. Castings could be rolled out in the same manner as ingot molds roll out ingots.

The idea is a delusion. Aluminum castings of intricate shape ARE being made in *permanent* molds, and, of course, kick plates also could be made, but unless the melt for aluminum kick plates is very large, the cost of installing permanent molds, with the royalties that must be paid, no doubt would be so large the castings produced by this method would cost more than sand made castings. If the kick plate patterns are put on molding machines the resulting output of castings will require a very energetic sales organization to dispose of them.

The material of these permanent molds is metal. It may be cast iron, high speed steel or an alloy containing considerable nickel. The only suitable nonmetallic substance is graphitic carbon and we do not believe that any maker of permanent mold aluminum castings has worked out a method of using this material, or cares to, because it is covered by patent. Plaster of Paris can be used for one casting only, and we are distinctly from Missouri when we hear of getting more castings from plaster molds than from sand molds.

Aluminum Melting Fails in Cupola

Will you please advise if aluminum can be successfully melted in the cupola? If so, kindly inform us how it should be charged and what proportion of coke should be used to the metal and what blast pressure is best. If a cupola can be used, we will use one about 15 to 18 inches inside diameter with two tuyeres. If a cupola cannot be used, state what kind of melting furnace would be best?

The cupola will, of course, melt aluminum but it will not do the work satisfactorily. Even if the temperature could be so regulated that the aluminum would not be superheated the loss of metal would be heavy because aluminum, when molten, is a viscid, sticky metal and clings to coke or other solid fuel in thin sheets and spatters and thus a large percentage of the metal is carried away. When pieces of coke fall into a crucible of melted aluminum, they become plated to a more or less extent with the metal and, as it sends little tentacles into the cavities of the fuel, it is detached with difficulty. Also the combination of carbon, nitrogen and oxygen aided by the silica of the cupola lining at high temperatures would attack the aluminum forming oxides and nitrides, thus drossing away much of the metal.

A good furnace for melting aluminum is an oil or gas-fired furnace in which the flame winds tangentially around a cast-iron pot containing the aluminum, the latter when liquid being dipped out, or the entire furnace is frequently tilted.

Seeks To Avoid Acid Dip for Coloring Brass

We are manufacturing a small brass handle or key the greater part of which is machined, but there is a part we cannot machine and which we dip to take the fire out and make it a brass color. We desire to learn of an inexpensive way of treating the mold in the foundry before the metal is poured to act in the same manner as the acid dip, so we would simply have to burnish it with steel balls to produce the bright effect of the machined portion; we want to dispense with the acid dip.

One practical way of avoiding the dipping process would be to make the castings of clean, new metal. Then they will come out of the sand a pleasant orange color if of red brass, and a reddish color if of yellow brass. Clean yellow brass does not come out of the sand yellow externally unless aluminum has been added.

For red brass use; copper, 88 pounds; tin, 4 pounds; zinc, 4 pounds; lead, 4 pounds. For yellow brass use; copper, 71½ pounds; zinc, 25 pounds; lead, 2 pounds; tin, 1½ pounds.

Bronze Latches Blow

We are making bronze latches and bolts and experience much trouble due to the tangs blowing. The castings are small but the latches are larger than the bolts, the latter come sound, but the latches blow badly. Can you advise us how to avoid this difficulty? Also we desire a mixture for a yellow brass that will cast and machine easily.

The iron inserts blow because they become damp while in the mold waiting for the metal. If the insert is colder than the sand of the mold, the moisture that fills the same will condense on the metal, then when the brass strikes it, steam is generated that forms a hole in the casting. One way to avoid this blowing is to spray the molds with molasses water, dust on flour, and leave them open on the floor until the metal is quite ready to pour, then a few minutes before the metal is brought to the molds, the latter are torched paying especial attention to the inserts to have them hot. Then the molds are closed, weighted and poured. As no moisture can condense on the inserts, if they are clean and free of rust and oxide film, no blowing is possible. If the above is too much work, it may be that a shrink ball in the cope attached to each casting so the metal will flow from casting to shrink ball, thus flowing out the first metal will give sound castings. It will be necessary with this latter method to thread a needle vent through each casting matrix to take off the steam through the cope. The extra work involved in getting these castings sound can not be avoided. A good casting yellow brass follows:

YELLOW BRASS MIXTURE

	Per cent
Copper	68.50
Zinc	28.00
Lead	2.00
Tin	1.50

Mixture for Yellow Brass

We desire to obtain a mixture for a cheap brass suitable for hinges; the alloy must not bend.

The following is a cheap brass;

CHEAP STIFF YELLOW BRASS

	Per cent
Copper	58.75
Zinc	40.00
Aluminum	.25
Tin	1.00

Entertain A. F. A. Tourists

British Extend Many Courtesies

Discuss New Pig Iron Tests

By Special Cable

EXCEPTIONAL cordiality has been evidenced in the reception tendered to the American foundrymen during their visit to England enroute to the Paris international congress. Large committees representing the industrial and civic organizations of the large centers on the itinerary have extended every courtesy and dinners and banquets have attested British hospitality.

The European tour of representatives of the American Foundrymen's association officially commenced at London last Saturday morning, Aug. 25, with a reception at the Hotel Cecil tendered by leading members of the Institute of British Foundrymen and the Iron and Steel institute. This was followed by a trip to Windsor castle where by special arrangement the private royal apartments were inspected. The party to Windsor castle included 100 persons of whom 35 members and ladies were Americans headed by President G. H. Clamer, of the American association, and V. E. Minich, a director in the association. The Americans were welcomed Saturday with a short address by V. C. Faulkner, president of the London branch of the Institute of British Foundrymen, who among other things said: "In a three-part mold, representing America, France and England, we are casting the full pattern of international amity."

Foundrymen's Work Laud

The brief London visit was concluded with an unusually brilliant dinner at the Hotel Cecil, Monday evening Aug. 27. Sir Robert Hadfield proposed the health of the American Foundrymen's association and mentioned the important work done by G. H. Clamer, Richard Moldenke, Stanley G. Flagg, Walter Wood, Enrique Touceda and John Howe Hall to whom the foundrymen of all the world are indebted. He also paid a special tribute to John A. Penton. He referred to the long connection between British and American technology, commencing with Benjamin Franklin who was a member of the Royal society. Admiral Sir George Goodwin, in support of the address of Sir Robert, said Americans were among the first to introduce science into the foundry. President Clamer in replying said that since the initial visit to England of former President A. O. Backert, of the American association, and return visits of Messrs. Stubbs, Firth and Cook, American foundrymen are well acquainted in England. He emphasizes the necessity of business men guiding post-war poli-

BANQUET TO A. F. A. VISITORS AND LADIES AT THE HOTEL CECIL. AUG. 27

cies instead of politicians, a nation being nothing less than a great business organization. Other speakers included Messrs. Minich, Stubbs and Cheesewright.

On Monday the party visited the works of Stone & Co., bronze propeller foundry, the Royal Naval college and Greenwich observatory.

Re-classify Pig Iron

Negotiations instituted by Walter Wood of R. D. Wood & Co., Philadelphia, and vice chairman of the committee on Cast Iron of the American Society for Testing Materials, with the support of Gulliam H. Clamer, president of the American Foundrymen's association, may result in important changes in the methods of classifying British foundry pig irons for export. At the present time iron is sold largely by fracture with only a few furnaces selling according to the approximate chemical analysis. As a result of conferences with Sir Hugh Bell, owner of many Middlesbrough furnaces; Arther Dorman, head of Dorman Long & Co., and Sir William Larke, director of the National Federation of Iron and Steel Manufacturers, the latter organization is circularizing its members regarding the grading of export pig iron by analysis with upper and lower limits of silicon and carbon, and upper limits of sulphur and phosphorus with penalties, premiums, etc, similar to the system now employed in the United States.

If these negotiations resulting from the visit of delegates of the American Foundrymen's association succeed, the entry of British irons into American markets will become easier.

During the week ending Sept. 1, the American party toured Sheffield and Manchester districts, arriving at Birmingham Tuesday. The delegation was met at Sheffield by Thomas Firth, G. Ernest Wells, John Hyde, W. A. McDonald and J. Shaw, president of the Sheffield branch of the Instituate of British Foundrymen. Members of the party visited the works of Hadfields Ltd. and the Edgar Allen foundries. On Wednesday luncheon was served at Hadfields at which time it was announced that P. B. Brown, managing director, had been elected a member of the Ancient Cutlers Co. of Sheffield.

Toast American Visitors

At a complimentary dinner given to the Americans Wednesday evening, Aug. 29, at which Mr. Shaw presided, Sir Robert Hadfield proposed a toast to the American Foundrymen's association. He traced the development of the steel casting industry at Sheffield which brought Mr. Clamer in his response, to declare that Pittsburgh must look to its laurels. Dr. Richard Moldenke, Watchung, N. J., for many years secretary of the American Foundrymen's association, and at present chairman of the committee on Cast Iron of the American Society for Testing Materials, plead for co-operation in maintaining quality standards through agreement on international specifications. Thomas Firth, who made an extensive trip through the United States last year urged American foundrymen to induce American boys, rather than foreigners, to learn the molding trade.

The climax of the English tour was reached Friday night Aug. 31, at a dinner given by the National Iron Founding Employers federation of which Oliver Stubbs is president. Mr. Stubbs, occupying the chair, warmly welcomed the Americans and read telegrams of greeting from Emil Ramas, president of the Association Technique de Fonderie de France; M. Leonard, president of the Association Technique de Fonderie de Liege, Belgium, and from C. E. Hoyt, secretary of the American Foundrymen's association; John A. Penton, first secretary of the association and A. O. Backert, past president. He again urged the necessity of co-operation of business men in the interest of peace and prosperity. F. J. Taylor, J. Brown and G. Longbottom also spoke for the National Iron Founders association, while President Clamer and Walter Wood responded on behalf of the Americans. Over 100 British manufacturers welcomed the delegation on its arrival at Manchester.

AT THE PLANT OF J. STONE & CO., CHARLTON, LONDON

Standing in front of car, left to right: H. G. Clavering, J. Stone & Co., London; Wesley Lambert, J. Stone & Co., and retiring president London branch, Institute of British Foundrymen; W. S. White, J. S. White Co., Pawtucket, R. I.; C. Earnill, Fay & Scott, Dexter, Maine & Copenhagen, Denmark; Col. W. F. Cheesewright, member of council, I. B. F.; P. J. Krentz, Buffalo Foundry & Machine Co., Buffalo, N. Y.; W. G. Hollinworth, secretary, I. B. F.; V. E. Minich, American Foundry Equipment Co., New York; O. S. Synder, Phoenix Roll Works, Pittsburgh, Pa.; C. H. Gale, Cleveland, O.; George Wadsworth, Wadsworth Core Machine Co., Akron, O.; R. E. Turnbull, Arcade Mfg. Co., Freeport, Ill.; W. R. Martin, American Steel Foundries, Chicago, Ill.; John Hill, Hill & Griffith Co., Cincinnati, O.

Standing on running board of car, left to right: George H. Kramer, Dayton Trust Co., Dayton, O.; Ralph West, West Steel Castings Co., Cleveland, O.; C. S. Gilbert, Canada Iron Foundries, St. Thomas, Ont.

In the car, seated, left to right: L. S. Lehman, S. B. Sexton Stove & Mfg. Co., Baltimore, Md.; V. C. Faulkner, president, Lincoln branch, I. B. F.; H. Cole Estep, THE FOUNDRY, London; William H. Nicholls, Wm. H. Nicholls Co., Brooklyn, N. Y.; James Linklater, Michigan Malleable Iron Co., Detroit, Mich.; Jesse L. Jones, Westinghouse Electric & Mfg. Co., Pittsburgh; G. W. Knotts, United Engineering & Foundry Co., Youngstown, O.; W. E. Dunn Jr., Southern Metal Trades Corp., Atlanta, Ga.

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Better Conditions Attract

CHANGE from the 12-hour day to the 8-hour turn in blast furnace operation will mean an increase in the cost of production of pig iron, for undoubtedly an increase in the hourly rate of pay will have to be made. This will not affect the individual foundryman, because while the price of pig iron may be increased it will be advanced alike to all foundrymen and none will be put to a disadvantage in reference to another. But castings producers might benefit from the lessons taught. It has been shown in some districts that a class of men who would not work at a blast furnace under the 12-hour shift now seek this kind of employment. This indicates that when the foundry industry is in need of more workers it will be able to obtain them through improving working conditions. Notable advances have been made in recent years, especially in some branches. An exception is noted in many foundries where the cupola tenders and charging gang have jobs which do not appeal to high-class workmen. Possibly better control of melting conditions could be secured through offering stronger inducements to a more intelligent class of workmen in these individual cases to be responsible for weighing up the charge and actually handling it into the cupola. One man cannot operate and charge the cupola, but is dependent upon those helping him who should be trustworthy and intelligent.

Forecast Progress in Smelting

SINCE means have been found to concentrate the oxygen content of the air and free it cheaply from the great excess of nitrogen, its application to metallurgical processes has been sought. One of the principal opportunities for the use of this gas in the metallurgical field has been found in its application in blast furnace smelting. Its application to the open-hearth and bessemer processes also is considered. Some of the advantages claimed for the use in the blast furnace of air enriched with oxygen are increase of the smelting heat per unit of fuel and of the present output per furnace, as well as the use of ore of lower iron content and of coke with higher ash and sulphur content. The introduction of such a process for the production of pig iron would be looked upon by the foundryman from a different viewpoint. He would want to know the effect of higher temperatures, and of a greater amount of impurities in the charge upon the product. Years ago, before chemical analysis had familiarized the foundrymen with the constituents of cast iron he used pig iron made either by the cold-blast process or in furnaces using a much lower blast temperature than now is general practice. He evidently had a superior iron in the cold-blast metal, and the majority of metallurgists would no doubt agree that the blast at lower temperatures produced an iron superior to that produced by the high temperatures of today. The modern foundryman has compensation in increased metallurgical knowledge and through the use of steel in the charge is able to produce iron of high strength and of considerable uniformity.

Trade Outlook in the Foundry Industry

DESPITE the condition of chaos which governs abroad, the anthracite coal strike which is in progress and the summer lull from which the industry is emerging, prospects in the foundry industry are bright. Those dominating factors which make for castings orders are favorable to a high degree. Railway traffic is heavy. Automobile manufacture and sales alike continue at a high rate. Building construction has taken a new lease of life. Retail sales are large and are steadily increasing. The agricultural outlook is much less drab than it has been painted.

Forward Orders Light

While operations, in the main, show slight improvement during early September, orders for castings, with few exceptions, are not placed far in advance of immediate requirements. A case in point is a large malleable foundry. At the start of September this company had sufficient business on its books to run 60 days at the present rate of production. However, if labor were available, and full plant capacity could be engaged it is same firm could complete its list of orders within a few days over one month. Malleable foundries, in general, are working at slightly better than 55 per cent of capacity. Automobile requirements which represent the largest single outlet for malleables in point of tonnage continue with a prospect of a fair fall business. Railway castings are sought, but not in the amounts noted in previous months. In July, according to the department of commerce, 58.9 per cent of the total malleable foundry capacity reporting was engaged. The total capacity given for 103 shops, representing probably 75 per cent of the total number of malleable foundries in operation is stated as 98,241 tons. The shipments of castings for the month are reported as 60,102 tons and the orders booked as 41,723 tons, indicating that the orders have practically equalled the production at the present rate of a little more than 55 per cent operations.

Prices of Raw Material for Foundry Use

CORRECTED TO SEPT. 7

Iron		Scrap	
No. 2 Foundry, Valley	$24.50 to 25.00	Heavy melting steel, Valley	$18.50 to 19.00
No. 2 Southern, Birmingham	23.50 to 24.00	Heavy melting steel, Pitts.	18.00 to 18.00
No. 2 Foundry, Chicago	27.00	Heavy melting steel, Chicago	16.75 to 17.25
No. 2 Foundry, Philadelphia	25.76 to 26.26	Stove plate, Chicago	18.00 to 18.50
No. 2 Foundry, Buffalo	25.00	No. 1 cast, Chicago	21.50 to 22.00
Basic, Valley	25.00	No. 1 cast, Philadelphia	20.00 to 21.00
Basic, Buffalo	24.00 to 24.50	No. 1 cast, Birmingham	19.00 to 20.00
Malleable, Chicago	27.00	No. 1 cast, Buffalo	19.50 to 20.50
Malleable, Buffalo	25.00	Car wheels, iron, Pittsburgh	20.50 to 21.00
Coke		Car wheels, iron, Chicago	20.00 to 20.50
Connellsville foundry, coke	$6.00 to 7.00	Railroad malleable, Chicago	22.00 to 22.50
Wise county foundry, coke	7.00 to 8.00	Agricultural mal., Chicago	19.50 to 20.50
		Malleable, Buffalo	21.00 to 21.00

Jobbing Active

Jobbing gray iron shops are active and the volume of small orders is highly satisfactory. Heavy foundries, particularly those serving the machine tool industry are not so fortunate, and roll foundries, dependent upon the state of the steel industry, are experiencing a slight falling away in orders Cast-iron pipe orders are light, but here again the volume of business at hand promises continued high production until requirements again mount. According to a new report issued by the department of commerce, the total tonnage of cast iron, bell and spigot pressure pipe produced in 12 shops during June was 81,208 tons which with shipments from stock gave a total of 88,318 tons delivered. At the same time the orders during the month called for 203,637 tons. In the same manner, the July production was 79,528 tons, and the total of orders booked was 187,345 tons. The total of the tonnage placed during June and July is 290 per cent of the output at the July rate of production. This indicates a continued activity in pipe shops for several months. Radiator, stove and furnace plants are not so busy as they were during the early summer months, but heavier operation is expected as a result of increased interest in building construction.

Iron Output Declines

August registered another sharp drop in the production of pig iron, according to the IRON TRADE REVIEW. The total output of 3,442,614 tons for the month shows a loss of 242,063 tons when compared with the July make of 3,684,677 tons. On a daily average basis, the August output was 111,052 tons per day and that for the previous month was 118,860 tons per day. This shows a decline of 7808 tons and the total is the lowest since February when the rate was 106,952 tons per day. The total output of merchant iron in August was 805,667 tons. Compared with the 900,946 tons for the previous month, this shows a loss of 94,859 tons in the merchant grades. August showed the production of merchant iron to be at the rate of 25,988 tons per day, compared with 29,048 tons per day for July and giving a decline of 3060 tons per day. The number of furnaces reported in blast on Aug. 31 was 273, the smallest total registered since January. Two merchant furnaces were blown in and 12 were blown out, leaving a total of 87 operating on melting grades. Foundries are buying iron more freely, but still hesitate to place orders covering a three or six months period in advance as formerly was the practice. Automobile sales are holding up exceptionally well for the season, and some manufacturers are placing contracts for castings extending into 1924. Truck and tractor sales are better than during the summer months. Railway buying is slack, with few orders for new cars and locomotives, but railway foundries are active and repair castings are in demand. The week of Aug. 25 marked a new high total of 1,069,932 cars loaded.

Nonferrous Shops Busy

Plumbers brass goods foundries are operating on a schedule which is satisfactory, and although orders are not extensive the volume of business in prospect is increasing. Nonferrous prices, according to the *Daily Metal Trade* of Sept. 7, follow: Casting copper, 13.62½c to 13.75c; electrolytic copper, 13.75c; Straits tin, 42.00c; lead, 7.00c; antimony, 7.50c; aluminum, No. 12 alloy, open market, 21.50c to 22.00c. Zinc is 6.55c to 6.60c, E. St. Louis. The average prices for August follow:

(New York Quotations)

Casting Copper	Electrolytic Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
13.853	14.095	6.759	39.346	7.664	25.829	6.339

Comings and Goings of Foundrymen

CHARLES E. HOYT, secretary of the American Foundrymen's association sailed from New York on the GEORGE WASHINGTON, Sept. 1, to join the representatives of the American Foundrymen's association who arrived in England on the LEVIATHAN Aug. 25. Mr. Hoyt joined the party and will accompany it during the remainder of the European tour.

Nelson Littell, assistant examiner of the metal founding classification in the U. S. patent office, has resigned to engage in the practice of patent law.

G. F. Murray, for many years associated with Naylor & Co., Inc., London, has joined the foreign trade department of Rogers, Brown & Co.

F. M. Wyss, formerly superintendent the Dunham Co., Berea, O., has been made foundry superintendent for the Michigan Gray Iron Castings Co., Detroit.

T. H. Harvey, works manager of the Ohio Steel Foundry Co., Springfield, O., returned recently from a tour of the United States on business for his company.

Newlin T. Booth, has been elected president of the Deemer Steel Casting Co., New Castle, Del. Other officers chosen were Charles F. Jenkins, vice president and treasurer, and George B. Harvey, secretary.

Horace C. Finkle, for seven years secretary and treasurer of the Portland Co., Inc., Portland, Conn., has resigned to become Detroit representative of the W. & B. Douglas Co., a subsidiary of the Premier Mfg. Co., Middletown, Conn.

Ralph A. Gardner, formerly with the General Electric Co. at its Lynn, Mass., plant, is now with the Stafford Co., Readville, Mass. Mr. Gardner started in the foundry business as a sales engineer for the Eagle Iron Foundry, Inc., Salem, Mass.

Seigfried B. Werner, president of the German Foundrymen's association, Dusseldorf, has been arrested on a political charge by the army of occupation. Dr. Werner was for some years connected with the Newburgh works of the American Steel & Wire Co., Cleveland.

Dr. L. H. Backeland, past president of the American Electrochemical society recently has been made Officier de la Legion d'Honneur by the French government. Dr. W. D. Bancroft, also a past president of the society, received the degree of doctor of science from the University of Cambridge, England, during his recent trip abroad.

Peter Cracium was transferred, Sept. 1, from the plant of the American Steel Foundries, Alliance, O., to the Chicago office of that company, where he has assumed the duties of general payroll auditor. He succeeds E. P. Medlan, who has left the employ of the company. Russell E. Reese has been placed in the position vacated by Mr. Cracium.

W. F. Richey, recently made superintendent of the Knox Stove Works, Knoxville, Tenn., was connected with the Lenoir Car Works, Lenoir City, Tenn. for eight years. During five years of this time he was assistant superintendent of foundries and for the past three years he has been superintendent of foundries for the Lenoir works.

Henry J. Bailey, formerly vice president of the Consolidated Machine Tool Corp. of America, has been selected to fill the presidency of that concern, vacated by the death of Waldo H. Marshall, Aug. 23. Mr. Bailey spent 33 years in the organization of Hillis & Jones, Wilmington, Del. He started with that company as an office boy and rose to the presidency, which position he occupied at the time of the absorption of that company by the Consolidated corporation. The headquarters of the corporation were moved to Rochester, effective Sept. 1.

Makes Numerous Changes in Personnel

A number of changes have been made in the personnel of the Mackintosh-Hemphill Co., Pittsburgh besides the election of J. Ramsey Speer to be president as announced in the Sept. 1 issue of THE FOUNDRY. J. E. Fawell, vice president in charge of sales and engineering, remains in the same position; J. H. Bode, formerly chief engineer, has been elected vice president in charge of operations; D. H. Baum, secretary, has also assumed the duties of assistant treasurer; and J. C. McFee, formerly of the sales department, has been elected assistant secretary and also made assistant to the president. Other appointments are E. C. B. Gould, assistant sales manager; William L. Ditges, assistant chief engineer; S. R. Willcock, manager of miscellaneous equipment, and C. H. Paul, comptroller. Remaining in their former positions are H. A. Lomax, manager of roll sales; Samuel McMillan; general superintendent of the Pittsburgh plant, and F. K. Acker, purchasing agent.

Discuss Brass Furnaces

At the fall meeting of the American Electrochemical Society in Dayton, Ohio, Sept. 27, 28 and 29, a round table discussion of brass foundry practice will be conducted by H. W. Gillett, chief alloy chemist of the bureau of mines. The importance of melting practices in nonferrous foundries is so great that it was decided to devote one session to it. The particular phases of the subject to be discussed at this meeting will be the applicability of different types of furnaces to different jobs, two or three shift operation of furnaces, induction furnaces in jobbing foundry work, comparison of large and small electric furnaces, refractories, and troubles in general.

Although melting nonferrous metals is one of the oldest human industries, ancient literature reveals a striking resemblance between the methods used long ago and those used in comparatively recent times. Important changes have been made in the handling and manufacture of bronze and brass, its successor, but little change was made in the melting of nonferrous metals until the advent of the electric furnace. The growth in the use of electric furnaces has been comparatively rapid. Four years ago no electric furnaces were in use, but today almost 500 are in service. Dr. Gillett says that in melting losses, thermal efficiency, heat control, handling of fuel, quality of metal and in preserving safe working conditions the electric furnace has points of advantage.

Safety Council Convenes

The twelfth annual congress of the National Safety council will meet Oct. 1 to 5, 1923, at Hotel Statler, Buffalo. A feature of the program will be the dramatization of the safety movement. This play was specially written for the occasion and will be produced every evening during the congress at the Allendale theater. Other entertainment features are being prepared. The program of speeches and discussions has also been announced. The subjects of special interest to foundrymen include

Handling Material in a Foundry, by B. F. Faunce, Bethlehem Steel Co., Johnstown, Pa.: Safety on the Plant Railway, by C. F. Dullenkopf, Bethlehem Steel Co., Bethlehem, Pa.; and Fire Protection in Steel Mills and Foundries, by J. M. Woltz, Youngstown Sheet & Tube Co., Youngstown, O. The first two addresses are scheduled for the morning of Oct. 3 and the third for Oct. 4. A playlet by the workers of the Edgar Thomson Works of the Carnegie Steel Co., Braddock, Pa., depicting a scene in a foundry will be presented in the afternoon, Oct. 3.

Announces New Officers

The Deemer Steel Casting Co., New Castle, Delaware, has elected Newlin T. Booth president, Charles F. Jenkins vice president and treasurer and George B. Harvey secretary. For the new board of directors Newline T. Booth, New Castle, Delaware, Charles F. Jenkins, Philadelphia, George B. Harvey, Chester, Pa., Selden S. Deemer New Castle, Del., David S. Cann, Philadelphia, J. Earnest Smith, Wilmington, Del., and I. J. Booth, New Castle, Del., were chosen.

Incorporate Company to Make Blowers

The Connecticut Blower Corp., Hartford, Conn., has been incorporated under the laws of Delaware with capital of $250,000 with M. E. Keeney, president, C. H. Keeney, treasurer, and C. E. Keeney, secretary. The company has taken over the International Blower Co. and the Hartford Sheet Metal Works. The products to be manufactured include blowers and exhaust fans, blower systems of all kinds, dust collecting, exhaust and ventilating systems.

Foundry Official Dead

Charles M. Miller, 69, treasurer of the Superior Foundry Co., Cleveland, died Aug. 2 at his home in that city, after a lingering illness of four months.

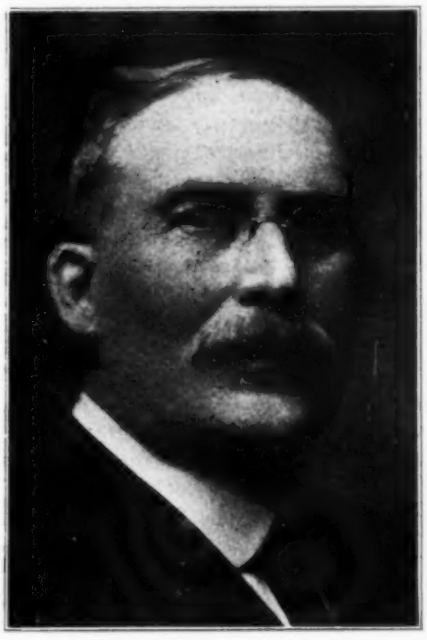
Mr. Miller organized the firm when he first came to Cleveland from Mansfield, O., thirty years ago. He was a graduate of the Philadelphia College of Pharmacy, Philadelphia, and a member of the Excelsior and Oakwood clubs.

Before coming to Cleveland he had been practicing pharmacy at Mansfield. The foundry which he originally organized is the present Superior Foundry Co. and is one of the largest jobbing gray iron and piano plate foundries in the United States.

He is survived by his widow, a son, Lester I. Miller, vice president of the foundry company, and a daughter, Mrs. Sidney P. Schloss.

James A. Beckett Dies

James A. Beckett, Troy, N. Y., assistant consulting engineer for the American Malleable Castings association, and acting field representative for that organization, died Wednesday, Aug. 22. Mr. Beckett was born in the north of Ireland in 1855 and came to this country at an early age. Shortly after his arrival he secured employment in the gray iron foundry of the W. A. Wood Mowing & Reaping Machine Co., Hoosick Falls, N. Y., where he began as a molder. He subsequently was made assistant foreman of the gray iron foundry, then foreman, and in 1895 he was appointed to be general manager of the plant, occupying that position until about 1910 when he resigned. He did not resume active duties until the beginning of the war when he became production engineer attached to the Rochester division of the ordinance office with headquarters at the Lackawanna Steel Co., Buffalo. After the war he became associated with the American Malleable Castings association co-operating with its engineering office in Albany, N. Y., in the position he held at his death. Mr. Beckett was a member of the American Society for Testing Materials.



JAMES A. BECKETT

Enrich Air with Oxygen

Possibilities of reducing costs in blast furnace, open-hearth and bessemer practice by a radical change in operating methods through enriching the air used for combustion with oxygen, are indicated in a booklet isued by the U. S. bureau of mines. This booklet contains a report by F. W. Davis, metallurgist on the possible benefits to be derived from the use of oxygenated air in iron and steel metallurgical processes and includes detailed heat calculations. The author advances as probable the following benefits to be derived from the use of oxygenated air in the blast furnace: Decreased cost of production; increase in the present output per furnace; increased flexibility of the process; greater uniformity of product; and the use of cheaper materials in the form of ore with a lower percentage of iron and coke with higher ash and sulphur contents. The process would give higher temperature in the book, but the effect of this increased temperature on the physical properties of the metal is not stated.

Change Separator Design

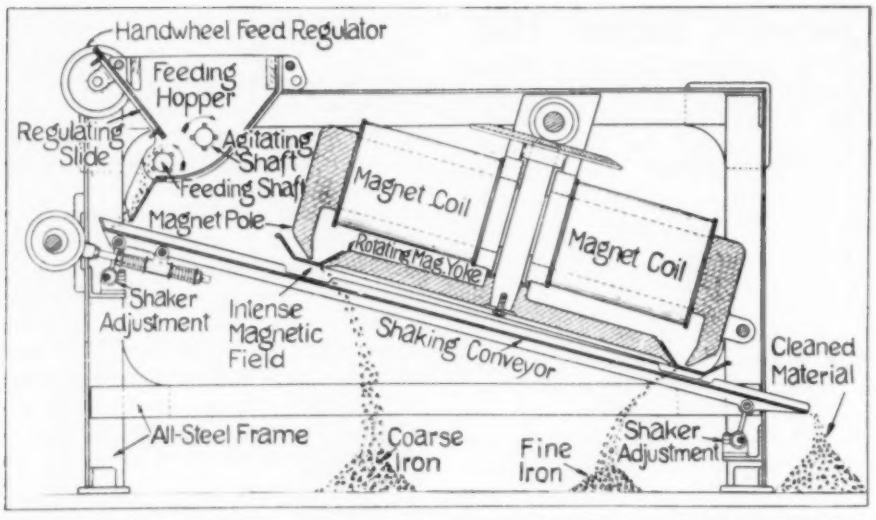
The Magnetic Mfg. Co., Milwaukee, is introducing a newly designed magnetic separator, which, it is stated, contains several improvements. The accompanying illustration shows in detail the operation of the separator.

The frame is made of structural steel, designed to confine the magnetic field to the point where separation takes place. According to the manufacturers the steel frame does not operate to affect the magnet nor the magnet the steel frame.

The magnet excited by direct current, has opposite poles and the point at the center of the magnet where no magnetic attraction is exerted is used to release the iron or other magnetic substances collected from the incline conveyor beneath the magnet separator. Between the two poles of the magnet, as shown in the diagram, a magnetic yoke is rotated which carries the magnetic substances and drops them over the side of the conveyor. This circular, revolving yoke has a metal apron around its outer rim which does the conveying, but the main function of the yoke is to concentrate the flux of the magnet in the small spaces between the poles and the yoke. Both the pole and yoke castings are made of low-carbon steel, and the exciting coils are calculated to saturate the magnet.

The feed hopper is provided with an agitating and a feeding shaft geared together and driven from the outside cross drive shaft, and the feed regulator has a rack and pinion movement for adjustment by a hand wheel. The yoke is driven by gears revolving a shaft through the center of the magnet core. The gears are connected with the motor driving the entire machine.

The other features emphasized by the manufacturers include a shaker adjustment, and the placing of the entire



THE ROTATING MAGNET YOKE IS PLACED ABOVE THE SHAKING CONVEYOR RATHER THAN BELOW IT

magnetizing agency above the shaker instead of having part below. The purpose of the former is to keep the shaker at all times parallel with the magnet. It is also provided with an adjustment by which the fine and course material is automatically separated. The other feature is intended to remedy a defect caused by long pieces of metal held vertical by the separator, thus sweeping from the shaker part of the non-magnetic material and causing an appreciable loss.

Develops Lift Truck

To meet the demand for an electric truck capable of lifting weights up to 2500 pounds and requiring only one man to operate it, the Elwell-Parker Electric Co., Cleveland, has developed a new storage battery lift truck. It is driven by an electric motor, and both the front and rear trucks may be steered. The load is supported mainly beyond the front axle by two right-angle forks regulated by another electric motor, which operates through a worm gear reduction attached to a movable plate supported on the truck frame by three rocking links. These forks may be shaped at the outer ends so as to be inserted beneath a bundle, box, casting, or other irregular shaped piece. With this construction the length of the arms which bear the weight must be proportioned to the weight so that the front axle is not overburdened. The front axle on which most of the weight rests is especially heavy with a wide spread of large roller bearings. The other features emphasized by the manufacturers are the chrome-vanadium universal joints on the drive shaft and the elimination of the kick at the steering handle when the truck strikes an obstacle on the floor by putting the steering knuckles close to the center of the wheels.

THE LOAD HANDLED BALENCES AN EQUAL WEIGHT OF THE TRUCK BACK OF THE AXLE

Make Spindle Sander

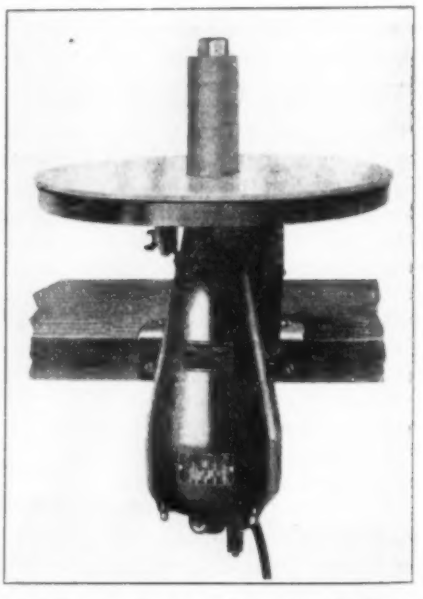
A small, oscillating-spindle sander has been developed by the Porter-Cable Machine Co., Syracuse, N. Y., which is designed in particular for a pattern shop or woodworking factory which does not have sufficient internal or irregular work to warrant the use of a larger machine. The sander may be clamped to a table as in the illustration or it may be placed on a pedestal if desired. It is completely enclosed and operates at a speed of 1725 revolutions per minute. The motor is connected directly through the spindle which has an oscillating movement of 1 inch. The table of the machine is finished to a smooth surface, tilts 45 degrees down and 15 degrees up.

Moisture Condenses on Chills Over Night

Question: We are having trouble with blows on the chilled edges of our plow points. The chills are oiled and we have tried pouring the molds on a slant, first with the chill on the high side and afterward with the chill on the low side, but without any improvement. We have made no recent changes in our mechanical staff, but we have noted that our loss on Monday, over the week end, is greater than on any other day of the week. The appearance of the chilled edge of the casting suggests that the metal was in violent commotion while the mold was filling.

Answer: Your trouble is caused by moisture condensing on the face of the chills and is inevitable so long as molds are made of sand and chills are made of iron. Under normal conditions the amount of moisture collected on a plow point chill in 5 or 6 hours will not affect the molten iron poured into the mold, but beyond that time it will cause trouble. Molds left over night will produce more scrap than good castings. Where the molds are made in two part flasks and, therefore, may be taken apart after they are closed the moisture may be removed with a piece of waste or a torch shortly before casting time on the following day, but where the molds are made in snap flasks this cannot be done.

The Fuller Engineering Co., Fullerton Pa., has arranged to act as sole licensees in the United States and Canada for all new business of the Quigley Fuel Systems, Inc. The engineering personnel of the latter company has become associated with the Fuller company.



SPINDLE SANDER MAY BE SCREWED TO A BENCH OR MOUNTED ON A PEDESTAL

Equipment Market Reviving

Sales Increase Only Slightly Over the August Average Which Is Low but the Volume of Substantial Inquiries Received Is Markedly Greater—More Activity in General Trade

SLIGHT increases in activity are noted in the equipment market, both in new orders and in inquiries. The new orders have increased only in a limited degree over the summer's average, but inquiries have been stimulated markedly. A new foundry building to cost $50,000 is planned by the Galion Iron & Mfg. Co., Galion, O. The structure is to be 50 x 160 feet. Althan Jones, Market building, Galion, is engineer. S. G. Lomax, Readsville, N. C., contemplates the erection of a gray-iron foundry to make 6 tons of castings daily and is interested in purchasing a cupola. Sales of sand-blast equipment have been made by the Pangborn Corp., Hagerstown, Md., as follows: Bradley & Hubbard Co., Meriden, Conn., sand-blast equipment; Lavelle Foundry Co., Anderson Ind., sand-blast and two dust arresters; Standard Sanitary Mfg. Co., Louisville, Ky., sand-blast and dust arrester; Packard Motor Car Co., Detroit, sand-blast equipment and dust arrester; Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., dust arrester; H. V. Dockray Brass & Iron Co., Zanesville, O., sand-blast equipment; and the National Malleable Casting Co., Toledo, O., sand-blast equipment. Little business has been done recently in core ovens. The F. A. Coleman Co., Cleveland, is installing an electrically heated unit at the Marion Malleable Iron Works, Marion, Ind., and have other inquiries for this type oven. Four large ovens have been sold by the Foundry Equipment Co., Cleveland, to the Norfolk & Western railroad for its foundry at Roanoke, Va.

Sales Made in Pittsburgh District

APPROACHING fall business, which in the Pittsburgh area is expected to attain sizable proportions, is sending various foundries into the equipment market. To a certain extent, inquiries are being turned into orders, although so far the majority are for small supplies, purchases of flasks, wheelbarrows, shovels, etc., being fairly numerous. A foundry in Monongahela City, Pa., has closed on a number of wheelbarrows and the Westinghouse Airbrake Co., has purchased a number of special flasks from an Ohio maker. Typical flask inquiries are as follows: fifty 20 x 24-inch and one hundred 14 x 22-inch. A few inquiries are out for sand handling and cutting equipment, but cupola inquiries are rare. In this immediate vicinity, no cupola orders lately have been placed although the Jeffrey Mfg. Co., Columbus, O., bought a No. 6 from the Whiting Corp., and this same builder sold one No. 4 cupola with accessories and a tumbling barrel to Scott & Williams, Inc., Laconia, N. H., and a No. 4 cupola to the Bassick Co., Meriden, Conn. During the past week or 10 days, the molding machine market has demonstrated more life than in the preceding four weeks; a large number of inquiries have developed and several sales have been consummated. Included in recent orders coming to the Herman Pneumatic Machine Co., Zelienopla, Pa., are the following: The National Car Wheel Co., Homestead, Pa., one car wheel machine; the Dayton Malleable Iron Co., Dayton, O., one jar stripping plate machine; the Standard Engineering Co., Elwood City, Pa., one jarring machine; the Chapman Valve Mfg. Co., Indian Orchard, Mass., two rollover machines; the National Cast Iron Pipe Co., Birmingham, Ala., a special pipe machine; the Pacific Sanitary Mfg. Co., Richmond, Cal., a bathtub machine, and the Francis & Nygren Foundry Co., Chicago, one jar rollover machine. Interest in machine molding practice is spreading among sanitary companies and several are visiting modern foundries with a view of changing their own practice. Included in prospective purchasers in this group are the J. L. Mott Co., Trenton, N. J.; A. Weiskittle & Son, Baltimore, Md., and the Standard Sanitary Mfg. Co., Pittsburgh, for its large new foundry at Baltimore. Other foundry equipment too will be purchased by the latter company around the first of the year. Other prospective purchasers of foundry equipment are the Pittsburgh Malleable Iron Co., Pittsburgh, for a 1-story addition; the Venango Mfg. Co., Franklin, Pa., erecting an addition; the Lathwood Foundry Co., Pittsburgh, 3-story addition; and the United States Cast Iron Pipe & Foundry Co., Scottdale, Pa., new foundry, 105 x 260 feet. Some of these state they are not as yet ready to buy needed machinery.

A fair amount of crane and hoist equipment recently has been sold among the foundries supplying their wants in the Pittsburgh market. The Pittsburgh Plate Glass Co., for its new Creighton, Pa., plant and foundry, has closed on three cranes with an Alliance, O., builder. The Westinghouse Electric & Mfg. Co., South Philadelphia, Pa., purchased two 10-ton electric traveling cranes with 5-ton auxiliaries and with 47-foot 2½-inch span but without electrical equipment, from the Alliance Machine Co., Alliance, O. The Hooven, Owens & Rentschler Co., Hamilton, O., closed on a 3-ton, 2 motor, cab-operated, monorail hoist through the Pittsburgh office of the Milwaukee Electric Crane & Mfg. Co. The Mt. Pleasant Foundry Co., Mt. Pleasant, Pa., recently bought a 20-ton handpower crane from the Whiting Corp., which also sold one each, 5-ton and 6-ton, handpower cranes to the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. An electric furnace built by Wm. Swindell & Bros., Pittsburgh, has recently been installed by the Kelly & Jones Co., Greensburg, Pa. The furnace has some special features.

Dullness Reported in the East

TRADING in foundry equipment in the eastern district the past two weeks has been the slowest this year, as reported by equipment firms. Few new projects have come up and buying generally has been confined to orders for single machines for replacement purposes. With the vacation season nearing an end, however, and with increasing activity in the other branches of the metal working industry an improvement shortly is anticipated.

Possibly the largest order reported in this district of late includes complete equipment for a new plant for the Jones Foundry, Concord, Mass., this business going to the Whiting Corp. Lockwood Greene & Co., Boston, are the general engineers in charge. The Bassett Co., Meriden, Conn., reported recently as purchasing a cupola from the Whiting Corp., has closed on another to the same concern. The Poughkeepsie Foundry & Machine Co., Poughkeepsie, N. Y., has closed on a 500-foot monorail system to the Chisholm-Moore Mfg. Co. Plans are being prepared by the Davitt Foundry Co., Springfield, Mass., for replacing the portion of its plant recently badly damaged by fire. The loss, including equipment, is esti-

mated at $75,000. The Canion Motor Co., Equitable building, Baltimore, recently organized for the manufacture of motors, contemplates the erection of a large plant at Chester, Pa., including a foundry. However, work on plans have just begun, and it is likely that it will be several months before this project can be regarded as active.

Despite the dullness of the past few weeks, prices on the leading foundry equipment items have remained steady, with little prospect shown in the East of price reduction in the near future.

Moving Slowly in Chicago

FOUNDRY equipment is in slack demand in the Chicago market, and observers of the trade find activity of gray iron shops is much less than formerly. Steel and malleable shops are doing fairly well but there is lack of enthusiasm over the future to stimulate further buying of equipment. Some increase of inquiry has been noted the past few days and signs indicate a pick up in buying by the end of this month, perhaps sooner. The Studebaker Corp. has bought four special continuous-melt, heavy-duty cupolas of 90-inch shell, for its foundry at South Bend., Ind., from the Whiting Corp. Other cupola business has been lacking. No sales of tumbling barrels have been made recently, and only the larger sizes of ladles are active, demand for the smaller containers being nearly absent. Larger sizes in the helical geared type have been moving well. While crane builders find considerable inquiry and in some cases are unable to entertain new business because of their soldup condition, few of the cranes are for foundry use.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The Buckeye Casting Co., Lima, O., plans the increase of its capital from $25,000 to the $50,000 authorized.

The first mold in the new foundry of the Pacific Gas Radiator Co., Los Angeles, was poured recently.

Construction will start immediately on a new radiator foundry for the Miller Engineering Co., Norfolk, Va., on a site near the municipal terminal, that city.

The Ware Foundry Co., Ware, Mass., resumed operations in its rebuilt foundry recently. The main building was damaged by fire June 7.

The Lilley Foundry Co., 2272 Fifteenth street, Los Angeles, has purchased a 5-acre site at East Twenty-sixth street and Downey boulevard.

Plans are being drawn for a 1-story 50x160-foot foundry building for the Galion Iron & Mfg. Co., Galion, O. Althan Jones, Market building, that city, is engineer in charge.

The Aluminum Foundries, Inc., 234 South Wells street, Chicago, was incorporated recently with a capital of $100,000 and 4000 shares of no par value common stock.

A portion of the plant of the Pittston Stove Works, William street, Pittston, Pa., was damaged by fire recently with a loss of about $30,000.

It is reported that the Hatboro Stove Foundry and the Roberts & Mander Stove Co., Doylestown, Pa., are contemplating the construction of their own water works.

Additions costing about $17,000 will be built for the Moline Iron Co., Moline, Ill., including a 3-story pattern vault, a 1-story core room and a battery of core ovens.

The plant of the Roberts Motor Co., Sandusky, O., was damaged by fire to the extent of $75,000 recently. The Roberts company manufactures automobile and small boat motors.

A miniature foundry, equipped with a small electric furnace will be installed in the Milwaukee Vocational school, Seventh and Prairie streets, Milwaukee.

The Modern Brass Foundry Co., Inc., Indianapolis, Ind., filed suit in voluntary bankruptcy in federal court recenty listing liabilities at $14,763.66 and assets at $4,648.11.

James Allen, founder, Adams, Mass., has sold his property on Dean street in that town to the Gagner Mfg. Co. and has moved across the street to another building recently acquired.

Standard Sanitary Mfg. Co., Pittsburgh, is reported to have let the contract to Patoof & Bush, 118 West Liberty street, Louisville, Ky., for the erection of a foundry, sand blast, sand drier and oxyacetylene welding buildings of reinforced concrete and steel construction, in the latter city.

The contract for the erection of a 20x30-foot addition to the plant of the Connecticut Foundry Co., Rocky Hill, Conn., was awarded recently to Charles P. Waterman, Inc. The addition will be equipped for cupola service.

Adams & Ruxton Construction Co. was awarded the contract for the erection of extensions and improvements to the plant of the Moore Drop Forging Co., Fisk avenue, Springfield, Mass.

Plans for the construction of a 1-story brick and steel casting shop addition, 50x80 feet, have been completed by the Milwaukee Steel Foundry Co., 127 South Water street, Milwaukee.

The Toledo Car Wheel & Foundry Co., Toledo, O., has been sold to S. M. Jones Co., to provide for expansion. The Jones company recently completed a machine shop and sucker rod plant.

The Cadillac Motor Co., Detroit, has awarded the general construction contract for the erection of three foundries to the Austin Co., Cleveland. The foundries will be of brick and steel.

Construction of a fire proof pattern storage house, 40x90x100 feet, is being planned by the T. A. Cummings Foundry Co., 1338-1372 Cortland street, Chicago. The capital of the company was recently increased to $200,000.

Plans for a 1-story, 600x1800-foot, brick and structural steel foundry for the Ford Motor Co. River Rouge, Mich., are being submitted to A. Kahn, architect, 1000 Marquette building, Detroit.

The Day Evans Iron Works, Ind., Knoxville, Tenn., plans to equip a foundry, machine shop, forge and blacksmith shop and carpenter and woodworking shop here at an estimated cost of $200,000. It will manufacture mine cars, wheels and kindred products.

The American Brake Shoe & Foundry Co., 30 Church street, New York, plans to install equipment in its proposed new plant at North Kansas City, Mo., to provide for an initial capacity of 75 tons of brake shoes a day. Several units, costing $350,000 will be built.

Construction has been commenced on a new building to be known as plant A of the United States Cast Iron & Foundry Co., at Scottdale, Pa. The new building will be of sheet steel, 60x320 feet in dimension, and will replace the structure recently damaged by fire.

The Fostoria Foundry Co., Fostoria, O., subsidiary of the Electric Auto-Lite Co., did not commence operations Aug. 27 as expected due to defects in the new cupolas. The plant will be open as soon as necessary adjustments can be made.

The Wollaston Foundry Co., Norfolk Downs, Mass., iron founder and machinist, has been thrown into bankruptcy by three petitioning creditors whose claims total $1270.98. The business was established in 1810 and was incorporated in 1873.

The foundry and machine shops of the Oldsmar Mfg. Co., Oldsmar, Fla., have been taken over by the Oldsmar Automotive Accessory Corp. The plant is being converted to produce automobile accessories and parts and tractor replacement parts.

Wolff Mfg. Co., manufacturer of plumbing supplies, has purchased the foundry of the Brady Co., Western avenue and Forty-sixth street, Chicago. The Wolff company will turn the new plan into one of the largest bathtub foundries in the United States, having an initial capacity of 900 tubs a day.

The American Car & Foundry Co. has purchased a $50,000 plot of land for an addition to its plant at Blue Island, Gillespie, Ill.

The Eugene Foundry & Machine Co., Eugene, Oreg., has been incorporated for $20,000 by George W. Philler, James McGuire and R. T. Burghardt.

The Portage Foundry Co., Barberton, O., has been purchased and will be operated by the East Akron Casting Co. Both the Akron and Barberton plants will be used to manufacture tire cores and molds as under present operation. The capital stock of the East Akron company was increased recently from $90,000 to $250,000.

Construction of an $80,000 additional unit to its plant has just been completed by the Phillips & Buttorff Mfg. Co., Nashville, Tenn. This is one of the pioneer foundry companies of the South, having been originally formed in 1861, and now operating three complete foundries in addition to its shops.